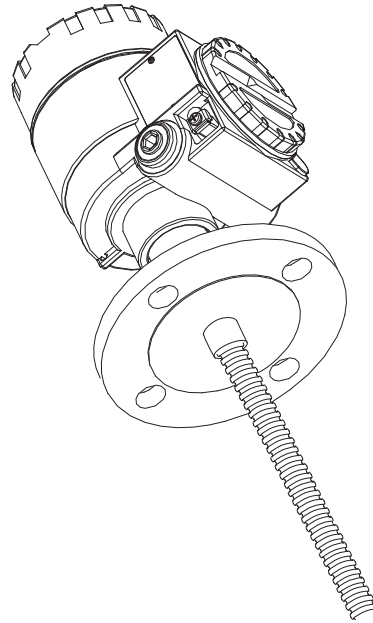


4532 Average Temperature Sensor and Converter



Installation and Operations Manual

For software version V1.45



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Safety Precaution Definitions

Caution! Damage to equipment may result if this precaution is disregarded.

Warning! Direct injury to personnel or damage to equipment which can cause injury to personnel may result if this precaution is not followed.

Safety Precautions

Read and understand this instruction manual before installing, operating or performing maintenance on the Varec 4532 Average Temperature Sensor and Converter. Follow all precautions and warning noted herein when installing, operating or performing maintenance on this equipment.

Contents

1	Introduction	1
1.1	Introduction	1
1.2	Installation and operation overview	1
1.3	Software history	1
1.4	System functional diagram	2
2	Safety instructions	3
2.1	Installation, commissioning and operation	3
2.2	Product Requirements	3
2.2.1	Power source	3
2.2.2	Use in hazardous areas	3
2.2.3	External connection	3
2.3	Operational safety	3
2.3.1	Hazardous area	3
2.3.2	Power supply	4
2.3.3	Grounding	4
2.3.4	Wiring	4
2.4	Return	4
2.5	Disposal	4
2.6	Notes on safety conventions and symbols	5
3	Identification	7
3.1	Device designation	7
3.1.1	Nameplate	7
3.2	Scope of delivery	7
3.3	CE marks, declaration of conformity	8
4	Installation	9
4.1	Design, dimensions	9
4.2	Unpacking	10
4.3	Flexible tube	10
4.4	Installation Instructions	11
4.5	Special conditions for safe use	11
5	Mounting	13
5.1	Mounting instruction	13
5.2	Mounting on a fixed roof tank	14
5.2.1	Top anchor method	14
5.2.2	Thermo well method	16

5.2.3	Anchor weight method	17
5.3	Mounting on a floating roof tank	19
5.3.1	Top anchor method	19
5.3.2	Thermo well method.	20
5.3.3	Guide ring and anchor weight method	21
6	Wiring	23
6.1	Terminal Connection.	23
6.1.1	4532 ATC terminal.	23
6.1.2	6000 Series Servo Tank Gauge terminal	24
6.1.3	4590 TSM i.s. terminal	24
6.2	Grounding	25
7	Operating.	27
7.1	Local HART connection	27
7.1.1	As a Varec tank gauging instrument.	27
7.1.2	As a standalone generic HART instrument	27
7.2	Device set up: 4590 TSM	27
7.2.1	HART scanner.	27
7.2.2	The 4532 ATC specific parameter set up on the 4590 TSM	28
7.3	Device set up: 6000 Series Servo Tank Gauge	28
7.3.1	Preparation of 6000 Series Servo Tank Gauge	28
7.3.2	4532 ATC configuration on 6000 Series Servo Tank Gauge	28
8	Operation and Description of Instrument Function	31
8.0.1	HART Device designation.	31
8.0.2	Device Data	31
8.1	Temperature measurement	31
8.1.1	Primary values: VH00 ~ VH09.	31
8.1.2	Element Temperature 1: VH10 ~ VH15	32
8.1.3	Element Temperature 2: VH20 ~ VH29	32
8.1.4	Element Position 1: VH30 ~ VH35 (VH36~VH39 is used only in 4539 ATC)35	
8.1.5	Element Position 2: VH40 ~ VH45 are not available in 4532 ATC	35
8.1.6	WB primary and Advanced temp: VH50 ~ VH59	37
8.1.7	WB Adjustment and Operation Power: VH60 ~ VH69	38
8.1.8	Temperature Adjustment: VH70 ~ VH79.	38
8.1.9	Device setting 2: VH90~VH99.	43
9	Maintenance.	45
9.1	Exterior cleaning	45
9.2	Repairs	45
9.3	Repairs to Ex-approved devices.	45
9.4	Replacement.	46

10	Troubleshooting	47
10.1	System error messages	47
10.2	Spare parts	48
11	Accessories	49
11.1	Anchor weight (Tall profile)	49
11.2	Anchor weight (Low profile)	49
11.3	Wire hook, Top anchor	50
12	Technical data	51
A	Order Structure	53
B	Declaration of Contamination Form	55
	Index	57

1 Introduction

1.1 Introduction

The 4532 Average Temperature Sensor and Converter (ATC) is a multi-element (Pt100) resistance device designed to measure the average product temperature in bulk liquid storage tanks. The measured value is converted into a HART® compatible output for use in temperature compensated volumetric calculations. The 4532 ATC contains up to 6 temperature elements, spaced at 2 or 3 meter intervals along the length of the probe. Power and local HART communications are provided over a 2-wire, intrinsically safe (i.s.) connection from compatible instruments, such as the Varec 6000 Series Servo Tank Gauge (STG), 7500 Series Radar Tank Gauges (RTG) and the 4590 Tank Side Monitor (TSM).

1.2 Installation and operation overview

Step 1. Installing on tank top

- The actual installation may require an installer to work in a hazardous area. Safety must be taken into account in order to avoid any harmful conditions.
- The installation method depends on the type of 4532 ATC. Refer to Chapter 4, Installation.

Step 2. Wiring to the host instruments (4590 TSM)

- Wiring material and conditions must be in accordance with intrinsically safe standards.
- One end (normally on the host instrument side) of the shield twisted pair of cables must be grounded at the terminal connection.
- Refer to Chapter 4, Installation.

Step 3. 4532 ATC initial setup

- Set up device settings for the 4532 ATC and the local HART setting to the host instrument.

Step 4. Data flow from the 4532 ATC to the host instruments

- Individual element temperature data: Individual row element temperature can be accessed regardless of liquid level information on the 4532 ATC's data matrix.

Average temperature data: The host instrument sends liquid level data on the HART line to the 4532 ATC. The 4532 ATC calculates both Gas / Liquid phase average temperature based on this given liquid level.

1.3 Software history

Software version / Date	Software changes	Documentation changes
V1.45/04.2006	Original software	

1.4 System functional diagram

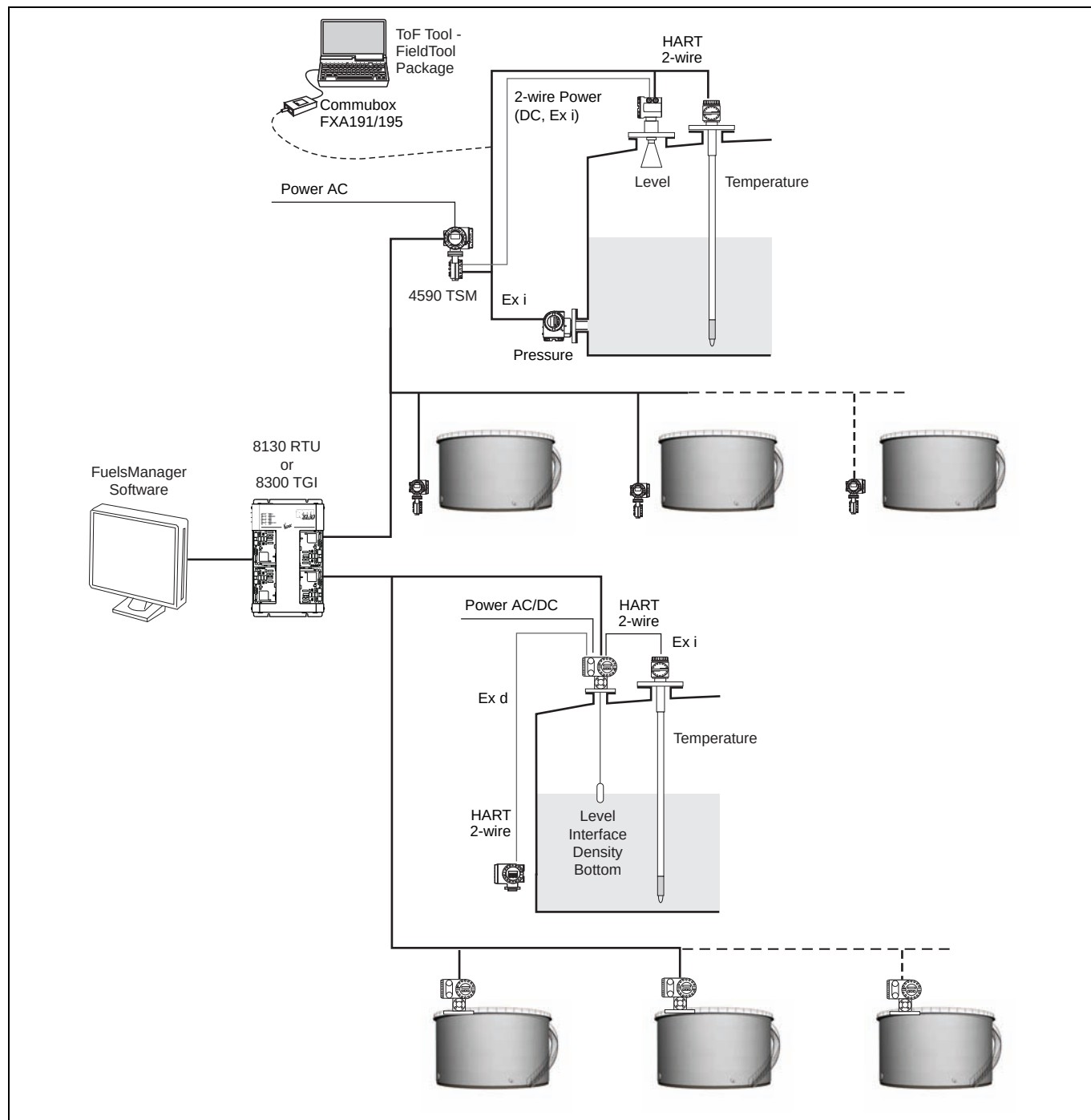


Figure 1-1: Connection with 7500 Series Radar Tank Gauge and 6000 Series Servo Tank Gauge

2 Safety instructions

2.1 Installation, commissioning and operation

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility.
- Personnel must absolutely and without fail read and understand this manual before carrying out its instructions.
- The instrument may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed without fail.
- The installer must make sure that the measuring system is correctly wired according to the wiring diagrams. The measuring system is to be grounded.
- Please observe all provisions valid for your country and pertaining to the opening and repairing of electrical devices.

2.2 Product Requirements

2.2.1 Power source

Check the voltage of the power supply before connecting it to the product. It should be the exact voltage required for proper operation of the product.

2.2.2 Use in hazardous areas

When using the product in the first or second-class hazard location (Zone 1 or Zone 2) be sure to use an intrinsically safe or pressure and explosion-proof apparatus. Take the utmost care during the installation, wiring, and piping of such apparatus to ensure the safety of the system. For safety reasons, maintenance or repairs on the product while it is being used with such apparatus should only be performed by qualified personnel.

2.2.3 External connection

When an external connection is required, the product should be protectively grounded before it is connected to a measurement object or an external control circuit.

2.3 Operational safety

2.3.1 Hazardous area

Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an *integral part* of this manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.

- Please use the explosion-proof type for measurement in explosion-hazardous areas.
- Instruments used in explosion hazardous areas should be mounted and wired according to the explosion-proof regulations.

- Instruments mounted in explosion hazardous areas must not be opened when the power is on. Tighten the cable gland firmly.
- The maintenance and repair of the instrument is limited to fulfill the explosion proof regulations.
- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.

2.3.2 Power supply

Check that voltage and frequency of the local power supply are in the range of the technical data of the instrument before turning on the power, in Chapter 12, Technical data.

2.3.3 Grounding

Do not remove the grounding of the instrument when the power supply is turned on. This may set the instrument in a dangerous condition.

2.3.4 Wiring

Make sure of the grounding of the instrument before connecting input and output to another system.

Caution! Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

2.4 Return

The following procedures must be carried out before the instruments is sent to Varec for repair:

- Always enclose a duly completed "Declaration of Contamination" form. Only then can Varec transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example, safety data sheet as per EN 91/155/EEC.
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.

A copy of the "**Declaration of Contamination**" is included at the end of this operating manual in Appendix B.

Caution! No instrument should be sent back for repair without all dangerous material being completely removed first, e.g. in scratches or diffused through plastic.

- Incomplete cleaning of the instrument may result in waste disposal or cause harm to personnel (burns, etc.). Any costs arising from this will be charged to the operator of the instrument.

2.5 Disposal

In case of disposal, please separate the different components according to their material consistency.

2.6 Notes on safety conventions and symbols

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding symbol in the margin.

Safety conventions	
Warning!	Warning! A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument
Caution!	Caution! Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
Note!	Note! A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned
Explosion protection	
	Device certified for use in explosion hazardous area If the device has this symbol embossed on its name plate, it can be installed in an explosion hazardous area
	Explosion hazardous areas Symbol used in drawings to indicate explosion hazardous areas. Devices located in and wiring entering areas with the designation "explosion hazardous areas" must conform to the stated type of protection
	Safe area (non-explosion hazardous area) Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas
Explosion protection	
	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	Grounded terminal A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	Protective grounding (earth) terminal A terminal which must be connected to earth ground prior to making any other connection to the equipment
	Equipotential connection (earth bonding) A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice

3 Identification

3.1 Device designation

3.1.1 Nameplate

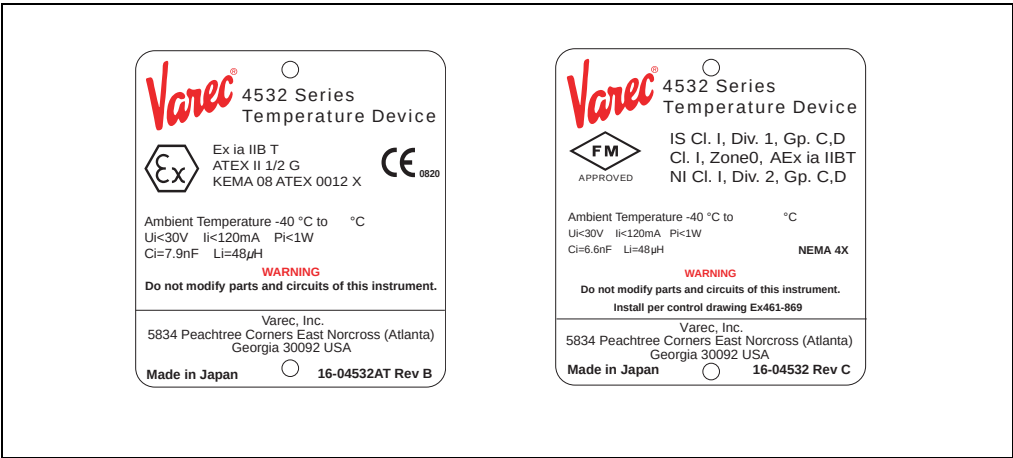


Figure 3-1: 4532 ATC labels

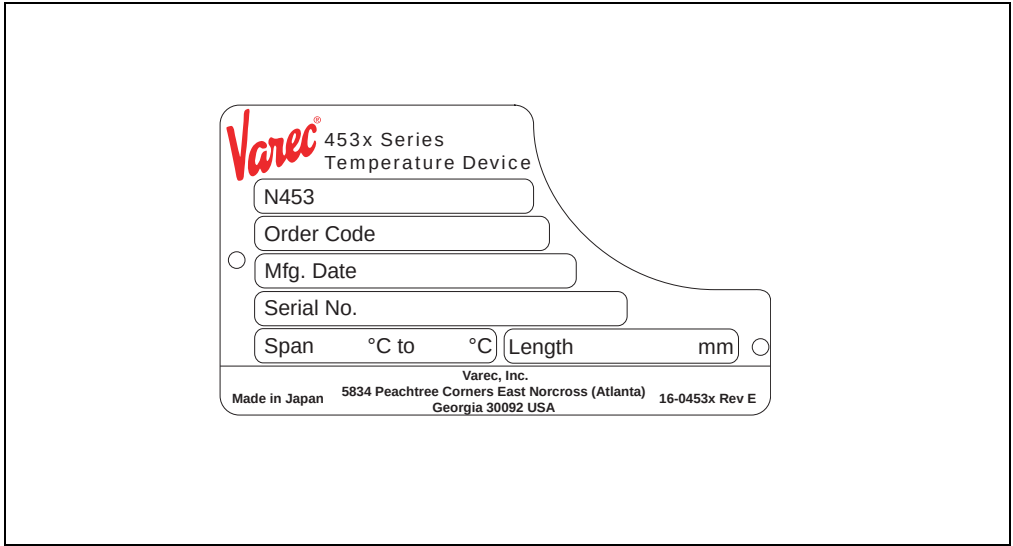


Figure 3-2: Product label for 453x average temperature devices

3.2 Scope of delivery

- Instrument according to the version ordered
- ToF Tool (CD-ROM)
- Accessories (as ordered)

3.3 CE marks, declaration of conformity

The instrument is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The instrument complies with the applicable standards and regulations in accordance with EN 50014 "Electrical apparatus for potentially explosive atmospheres-General requirements". The instrument described in this manual thus complies with the statutory requirements of the EG directives. Varec confirms the successful testing of the instrument by affixing to it the CE mark.

4 Installation

4.1 Design, dimensions

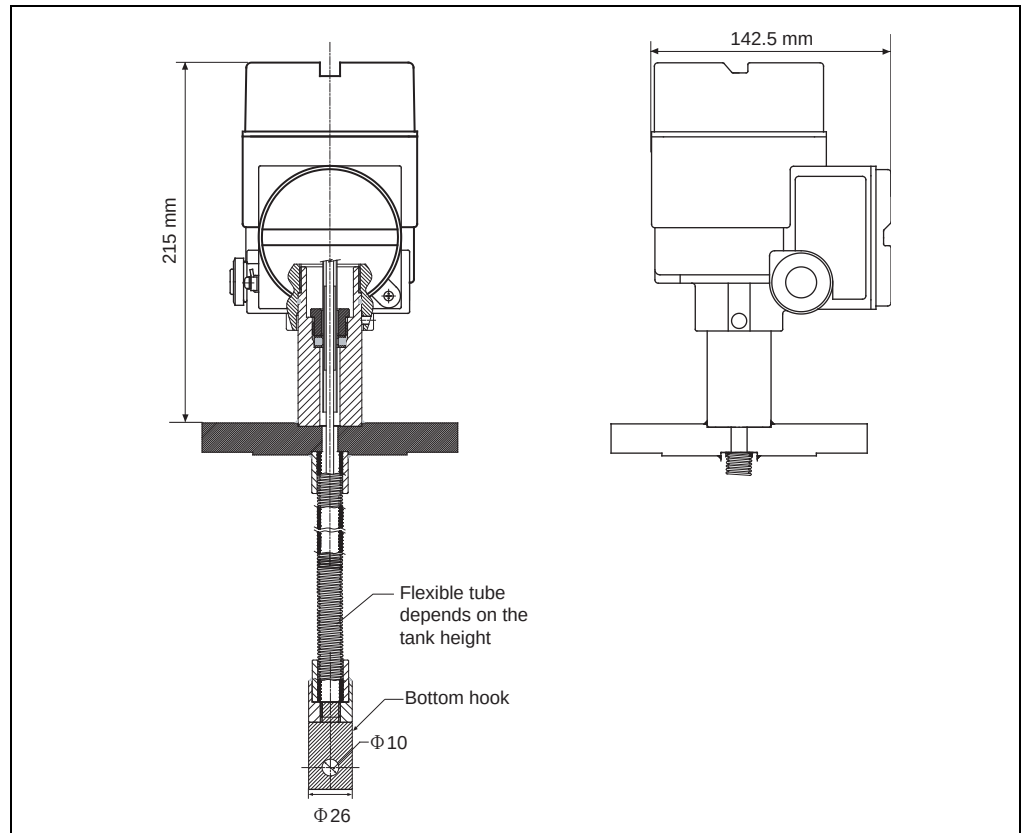
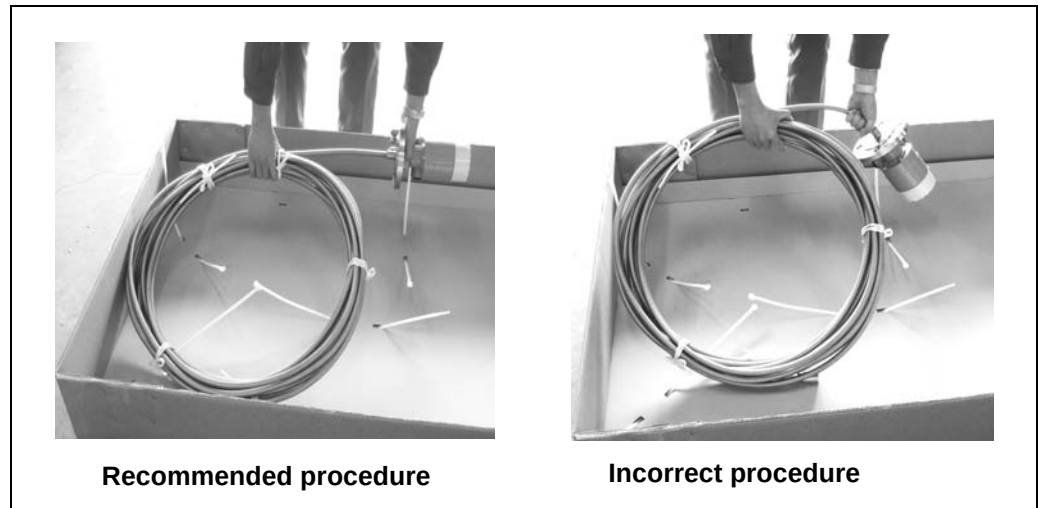


Figure 4-1: 4532 ATC dimensions

4.2 Unpacking

When unpacking, be careful not to bend, fold or twist the flexible tube. Please refer to the recommended procedure below.



4.3 Flexible tube

When attaching and bending the flexible tube, the radius of curvature must be at least 300 mm (11.8") at any bend portion.

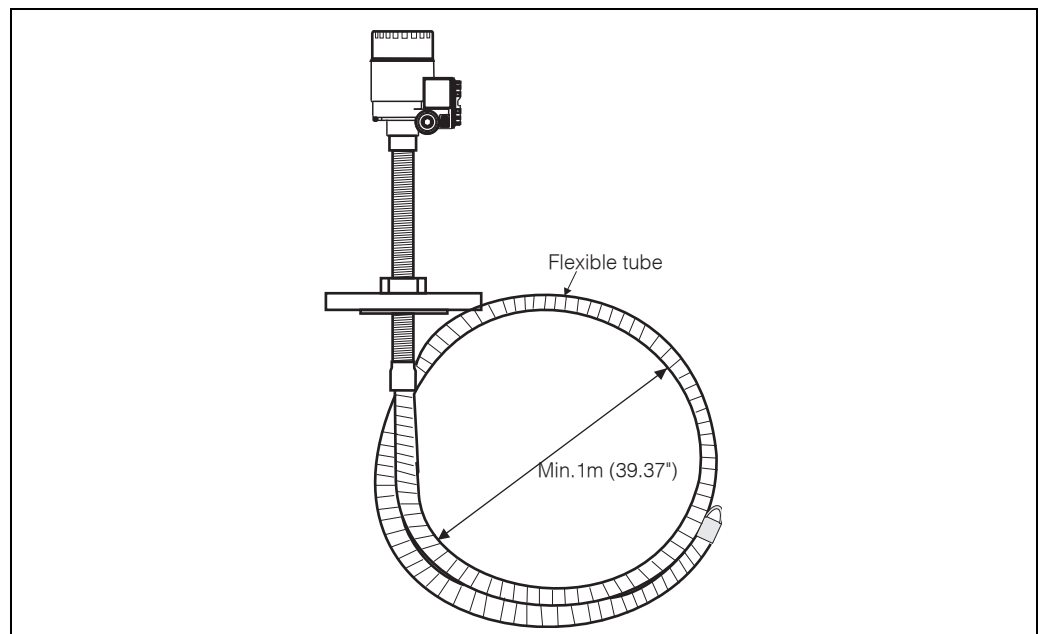


Figure 4-2: Flexible tube

Note! If a flexible tube is bent with a radius of curvature less than 300 mm (11.8"), the flexible tube or the measuring element may be seriously damaged or broken.

4.4 Installation Instructions

Note! The level sensor circuit is connected to ground and is infallibly galvanically isolated from the supply and output circuit and from the temperature measurement circuit.

All metal parts of the sensor and the transmitter shall be electrically conductive and securely be connected to the potential equalization system within the hazardous area.

4.5 Special conditions for safe use

To exclude ignition sources due to sparks caused by impact or friction, even in the event of rare incidents, do not subject the temperature sensor tube to environmental stress, such as impact from moving parts. Also, make sure the bottom part is secured.

5 Mounting

5.1 Mounting instruction

Note!

1. The flexible tube length of the 4532 ATC is defined for the customer's specifications. Before mounting, please check as follows:
 - The tag number (if available) on the body of the 4532 ATC
 - The length of the flexible tube
 - The number of measuring points
 - The intervals between measuring point
2. Mounting the 4532 ATC at a minimum of 500 mm (19.67") away from the tank shell. This will ensure that the measurement is not influenced by changes in ambient temperature.
3. The procedure for mounting the 4532 ATC on a tank depends on the type of tank. Here we shall explain the procedures for a fixed roof tank and for a floating roof tank.

In any case, the flexible tube head is mounted on the tank top as show in fig. 5.

The mounting nozzle should have a diameter of 50 mm (2") as standard.

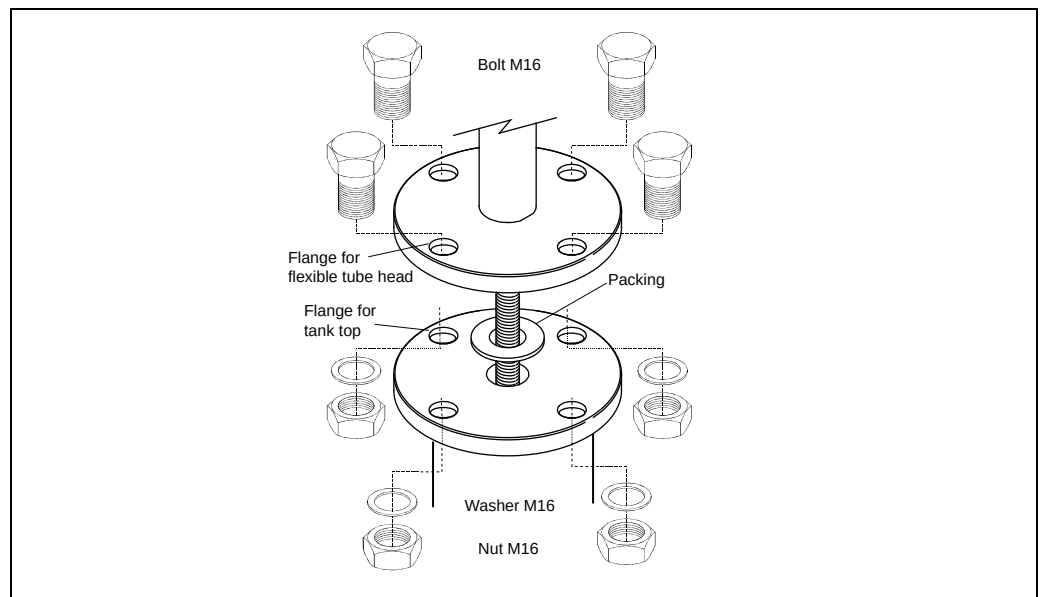


Figure 5-1: The 4532 ATC mounting

5.2 Mounting on a fixed roof tank

There are three methods for mounting the 4532 ATC on a fixed roof tank:

- Top anchor method
- Thermo well method
- Anchor weight method

If the tank bottom has a heating coil, the clearance from the flexible tube bottom hook to the tank bottom may increase depending on the heating coil type.

5.2.1 Top anchor method

The flexible tube is stabilized by a wire hook and a top anchor.

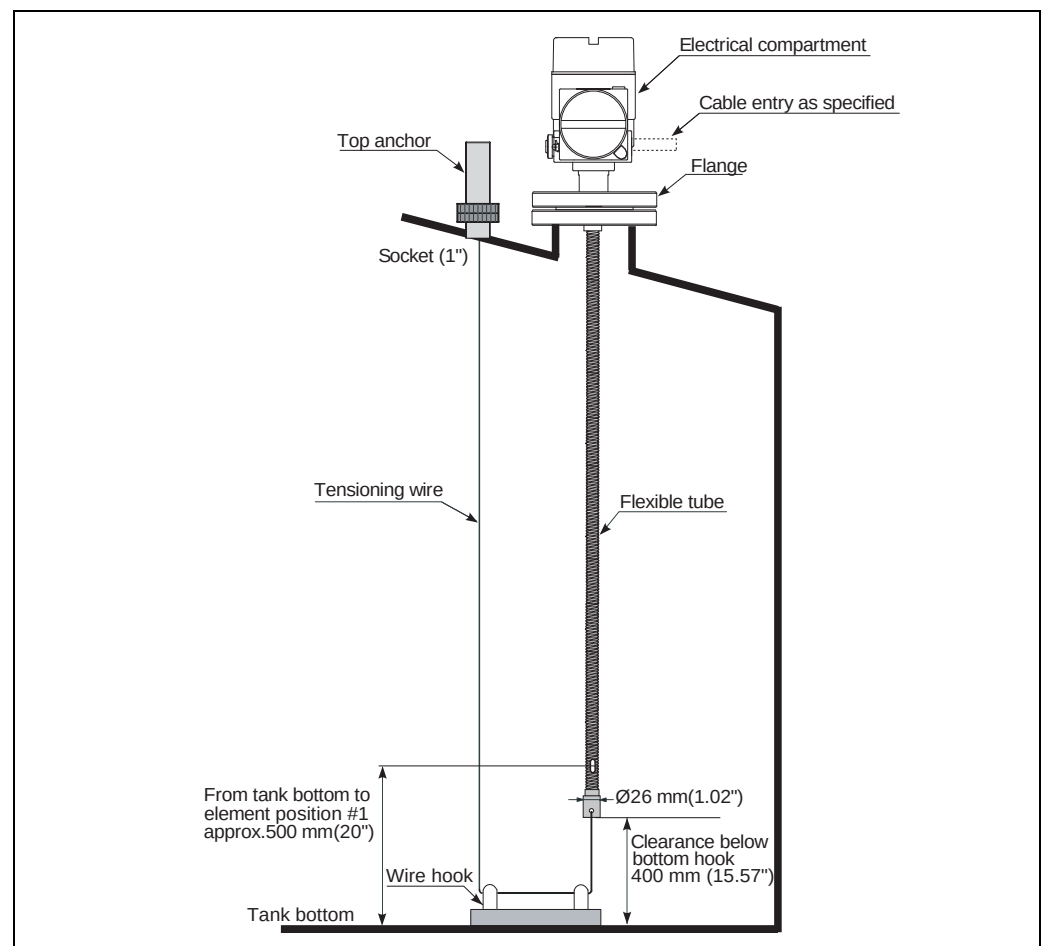


Figure 5-2: Top anchor application

1. Insert a gasket and lower the flexible tube from the nozzle on the tank top.

Caution! The flexible tube must be lowered carefully without bending too much and scratching at the inner edge of the nozzle hole.

2. Rotate the 4532 ATC so that you can set up the cabling in the most convenient way.
3. Straighten the tensioning wire, fix the wire end to the top anchor temporarily and lower the wire.

4. Draw the tensioning wire through the wire hook on the tank bottom.
5. Wrap the tensioning wire twice around the hole on the bottom hook, tighten it and wrap the provided wire around it (see Figure 5-3).

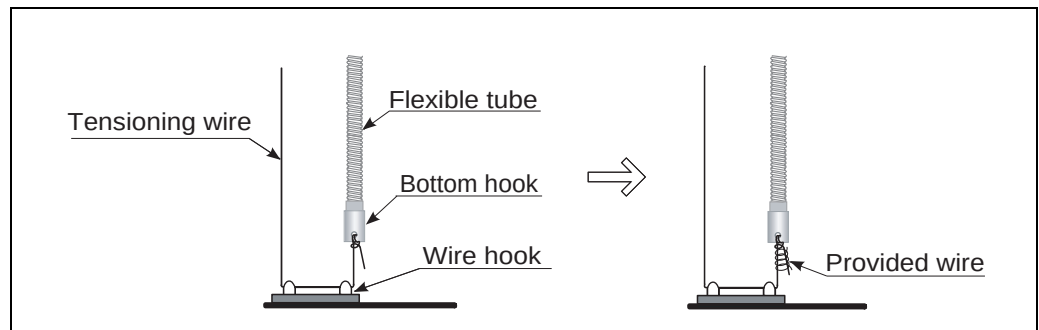


Figure 5-3: Tensioning wire mounting

6. Fix the mounting flange of the 4532 ATC to the nozzle on the tank top using bolts.

Note! Please keep the compression of the spring at 35 to 37 mm (1.38 to 1.47).
If you compress the spring over 35 to 37 mm, it may cause damage to the sensor.

7. Draw the end of the tensioning wire as much as possible by hand and foot (see Figure 5-4)
8. Bend the wire and fix it using the nut.
9. Cut the excess wire.
10. Screw the nut to compress down the spring of the top anchor 35 to 37 mm.
11. Cover the top anchor.

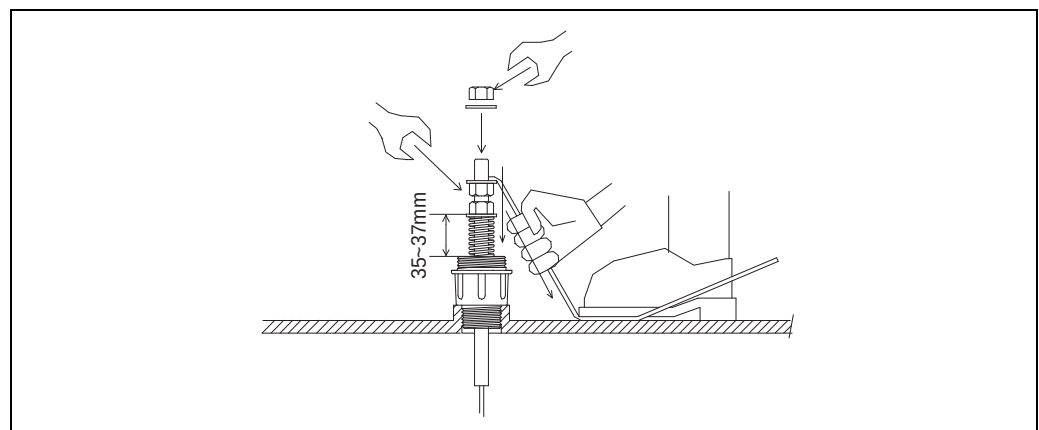


Figure 5-4: Top anchor mounting

5.2.2 Thermo well method

The flexible tube is inserted into a thermo well with a diameter of 2" or more.

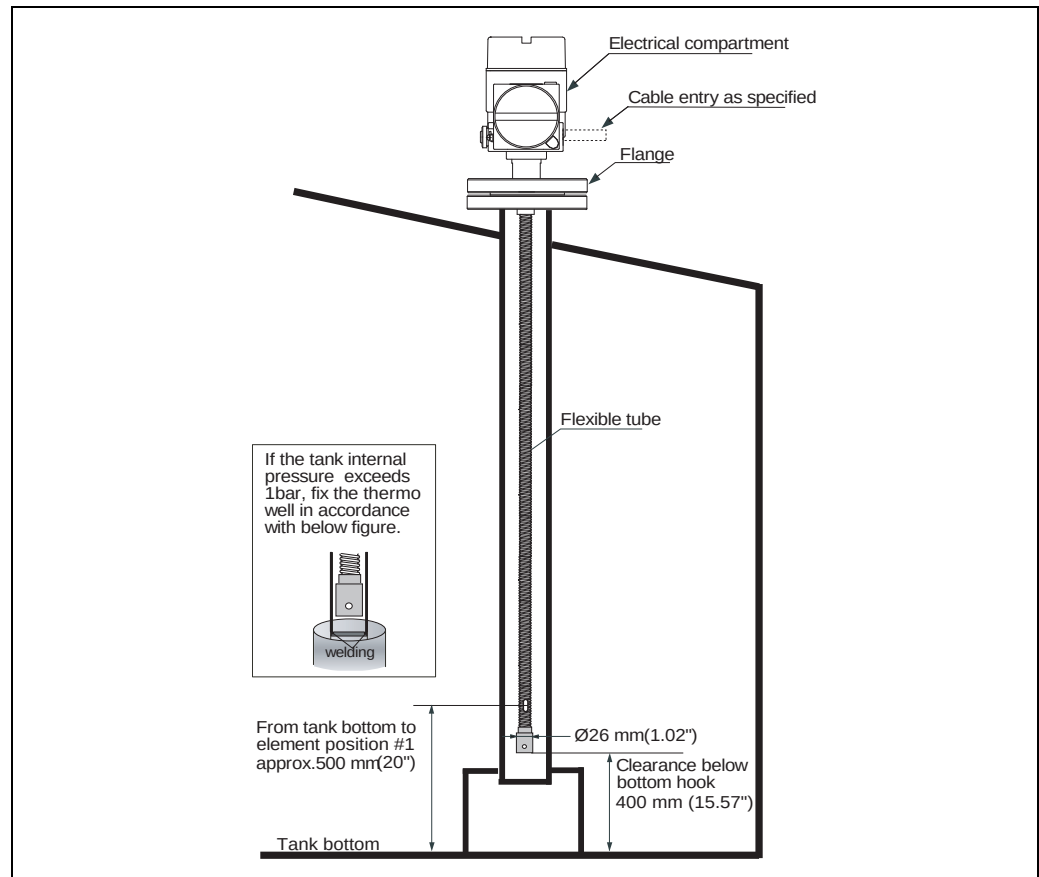


Figure 5-5: Thermo well application

Caution! The flexible tube must be lowered carefully without bending too much or scratching at the inner edge of the nozzle hole.

1. Insert a gasket and lower the flexible tube into the inlet of the stilling well.
2. Rotate the 4532 ATC so that you can set up the cable in the most convenient way.
3. Fix the mounting flange of the 4532 ATC to the nozzle on the tank top using bolts.

5.2.3 Anchor weight method

The flexible tube is stabilized by an anchor weight:

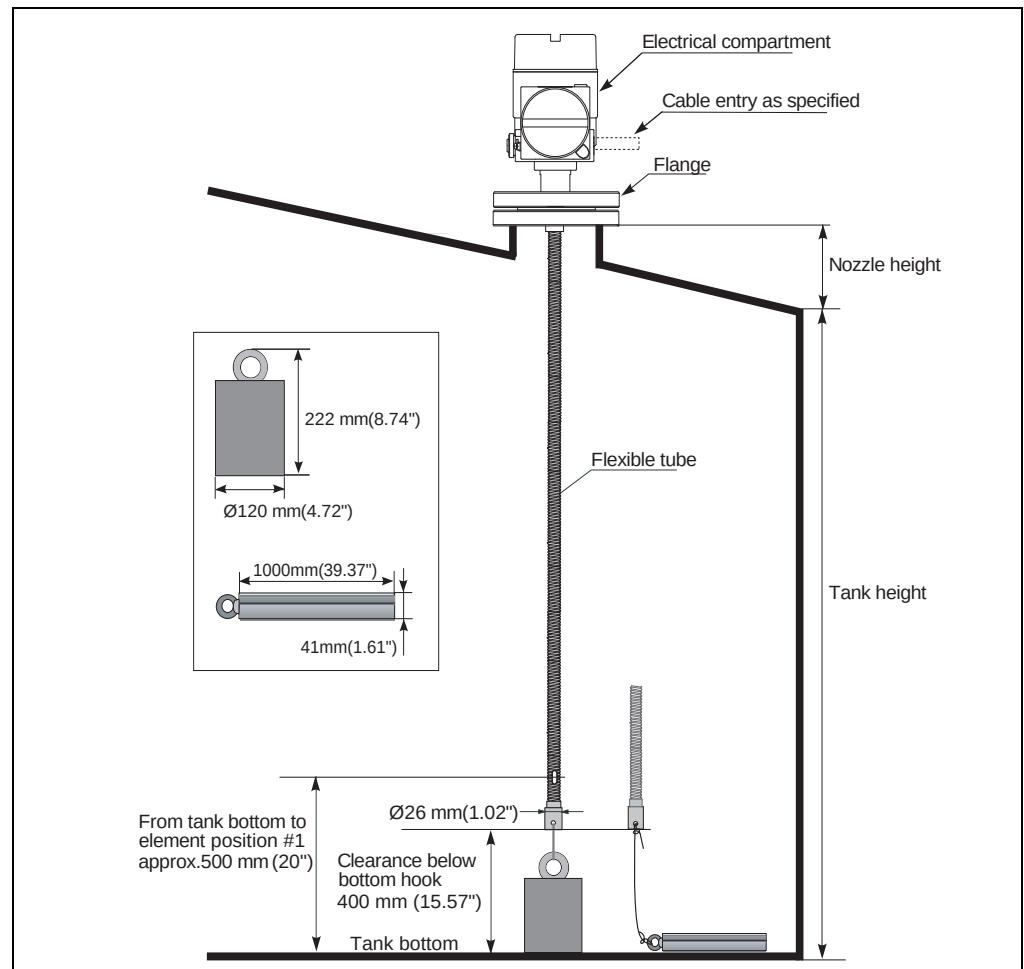


Figure 5-6: Anchor weight application

Note! Make sure to put the anchor weight on the tank bottom. When installing with the suspended anchor weight, please use the anchor weight at a maximum of 16 kg. More weight may cause internal breaking in the flexible tube.

Caution! The flexible tube must be lowered carefully without bending too much and scratching at the inner edge of the nozzle hole.

1. Insert a gasket and lower the flexible tube from the nozzle on the tank top.
2. Rotate the 4532 ATC so that you can set up the cabling in the most convenient way.
3. Tighten the tensioning wire between the lower end of the flexible tube and the anchor weight.
4. Wrap the tensioning wire twice around a hole on the bottom hook, tighten it and wrap a provided wire around it (see Figure 5-7 on page 16).
5. Fix the mounting flange of the 4532 ATC to the nozzle on the tank top using bolts.

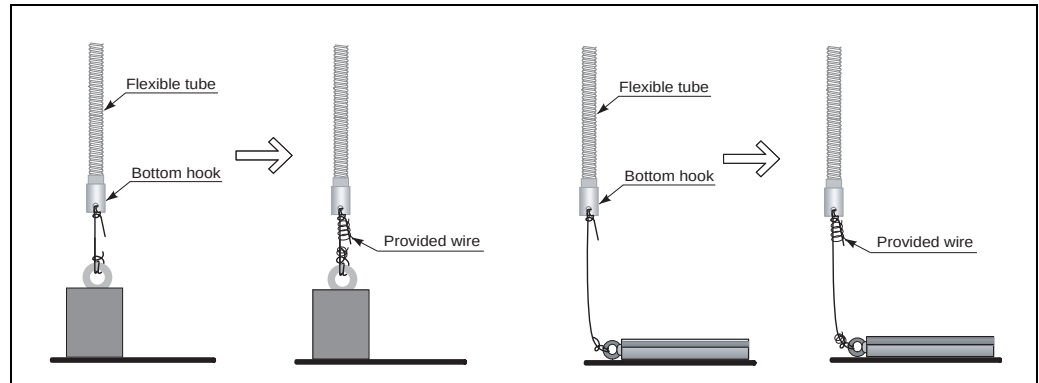


Figure 5-7: Anchor weight mounting

5.3 Mounting on a floating roof tank

There are three methods of mounting the 4532 ATC on a floating roof tank:

- Top anchor method
- Thermo well method
- Guide wire ring method

Note! If the tank bottom has a heating coil, the clearance from the flexible tube or probe bottom hook to the tank bottom must increase according to the heating coil type.

5.3.1 Top anchor method

The flexible tube is installed in a fixed pipe and stabilized by a top anchor. The 6000 Series Servo Tank Gauge and 4532 ATC can be mounted in the same fixed pipe.

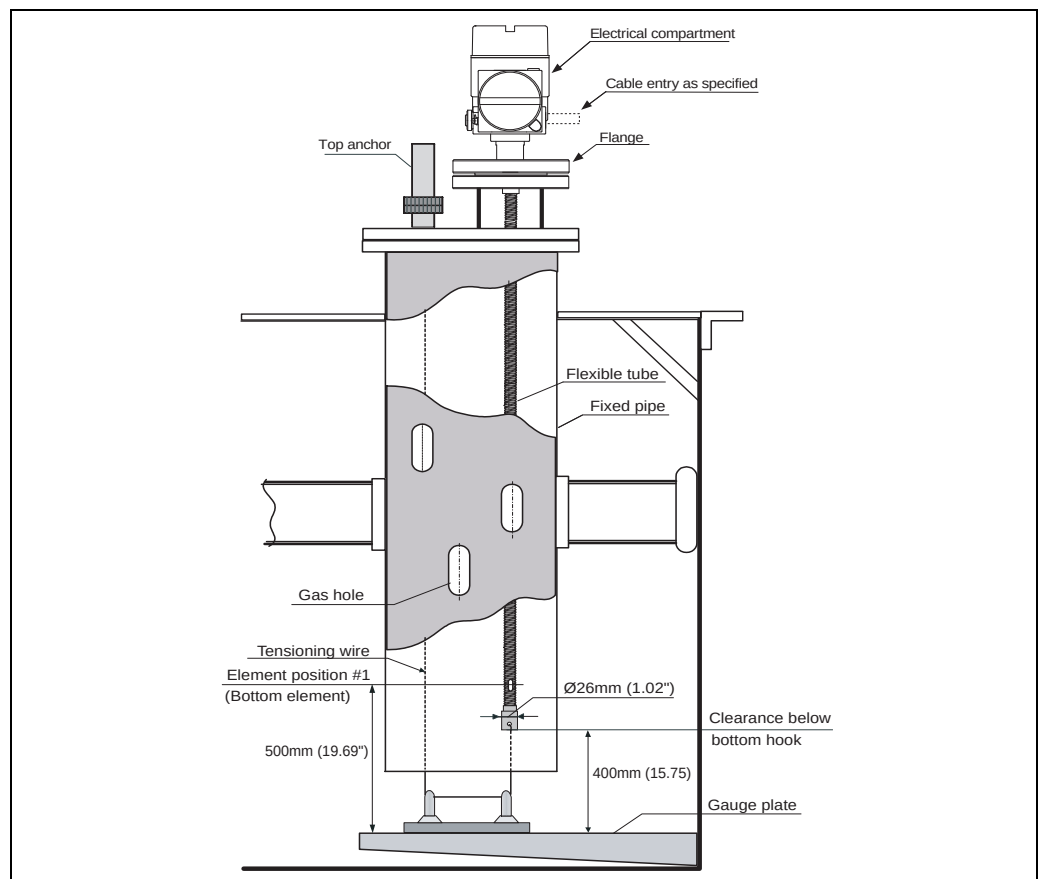


Figure 5-8: Top anchor application

The installation procedure is the same as for mounting on a fixed roof tank using the top anchor.

5.3.2 Thermo well method

The flexible tube is inserted into a thermo well in the fixed pipe.

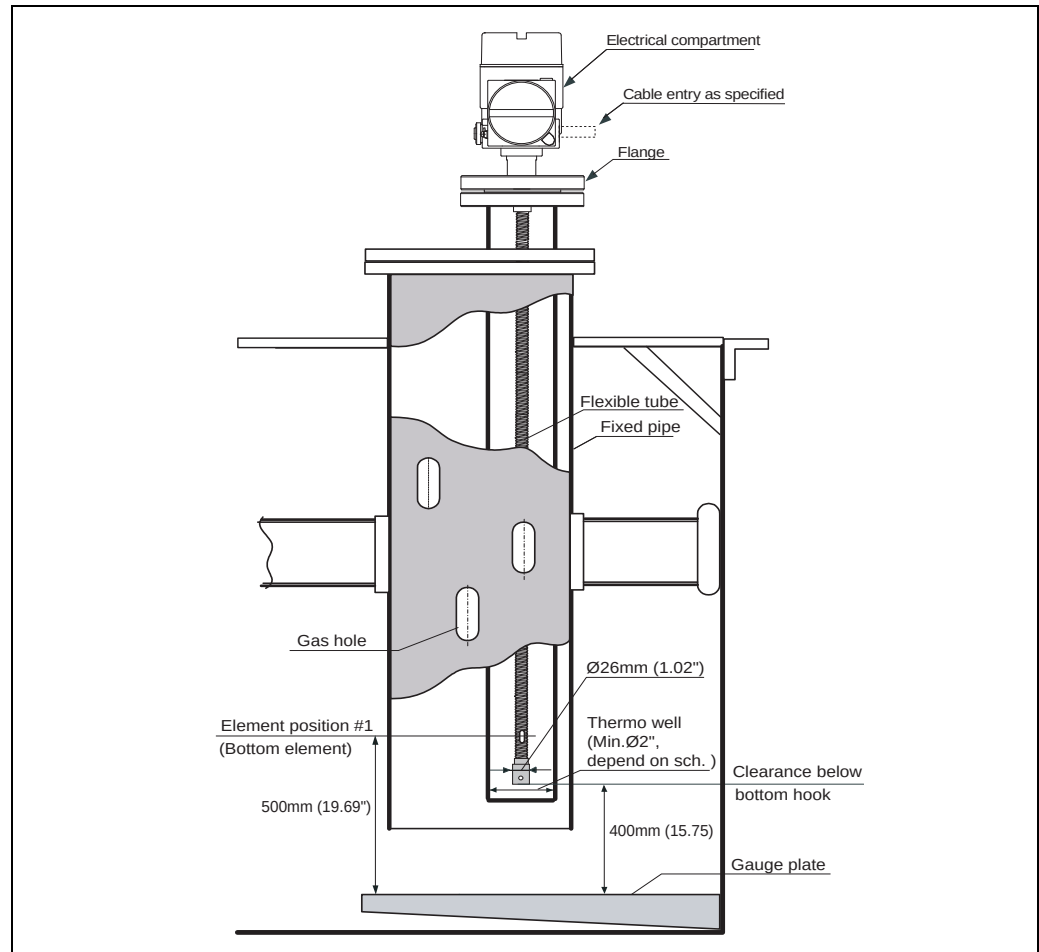


Figure 5-9: Thermo well application

The installation procedure is the same as for mounting on a fixed roof tank using the thermo well.

5.3.3 Guide ring and anchor weight method

The flexible tube is stabilized by a guide ring and anchor weight.

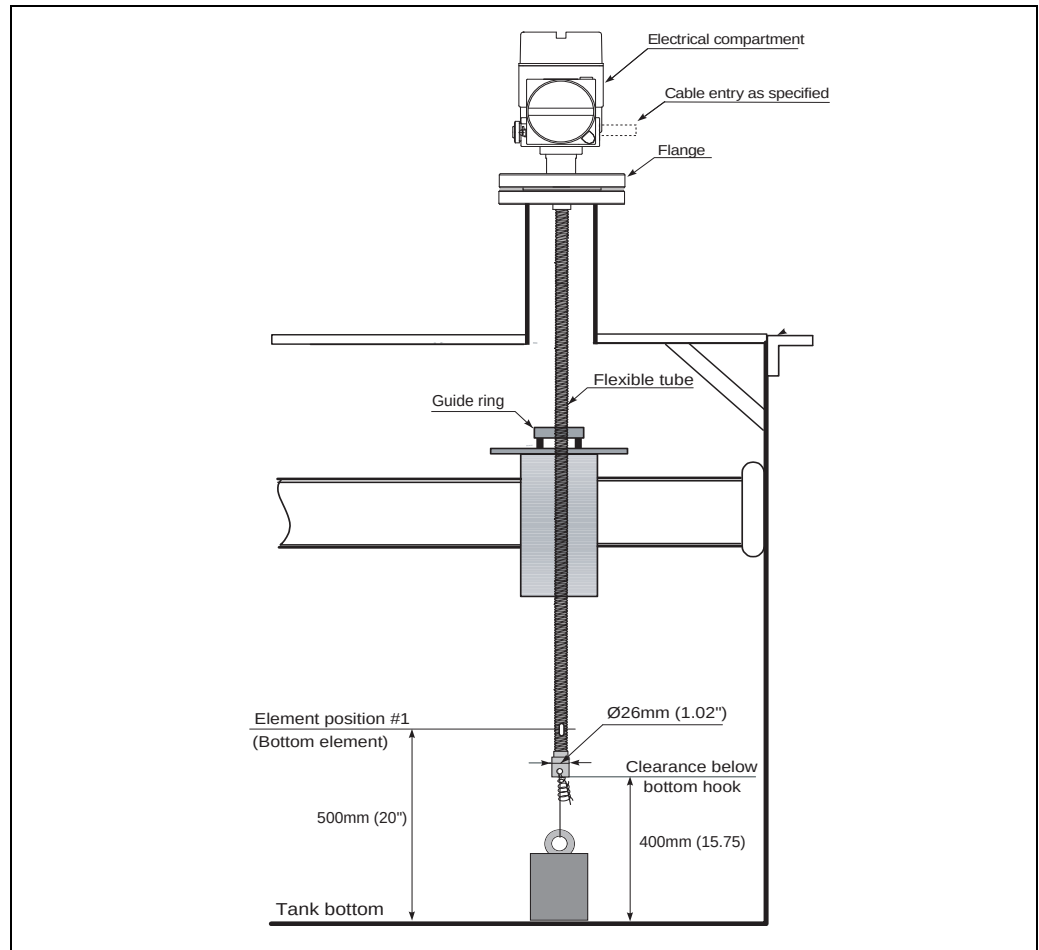


Figure 5-10: Guide ring and anchor weight application

Caution! Make sure to put the anchor weight on the tank bottom. When installing with the suspended anchor weight, please use the anchor weight at a maximum of 16kg. More weight may cause internal breaking in the flexible tube.

Caution! The flexible tube must be lowered carefully without bending too much and scratching at the inner edge of the nozzle hole.

1. Set the guide ring to the floating roof.
2. Insert a gasket and lower the flexible tube from the nozzle on the tank top.
3. Rotate the 4532 ATC so that you can set up the cabling in the most convenient way.
4. Tighten the tensioning wire between the lower end of the flexible tube and the anchor weight. Wind the tensioning wire twice around each of the hitches and wrap a wire around it (see Figure 5-7 on page 16).
5. Fix the mounting flange of the 4532 ATC to the nozzle on the tank top using bolts.

6 Wiring

6.1 Terminal Connection

6.1.1 4532 ATC terminal

Note! The 4532 ATC allows an intrinsically safe HART connection only. Please refer to the i.s. regulation for establishing wiring and field device layout.

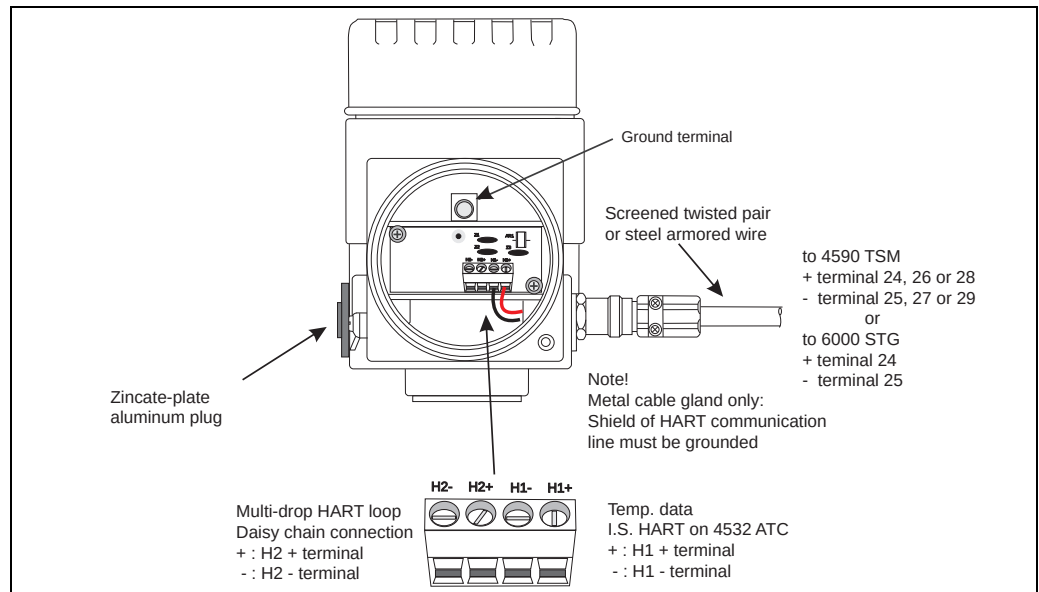


Figure 6-1: 4532 ATC terminal

The 4532 ATC has convenient daisy chain HART loop terminals that enable the 4532 ATC to be a terminal junction for HART multi-drop instruments.

6.1.2 6000 Series Servo Tank Gauge terminal

Since the 4532 ATC is an intrinsically safe instrument, the terminal connection to the Ex i side on HART connection is allowed on the 6000 Series Servo Tank Gauge terminal housing.

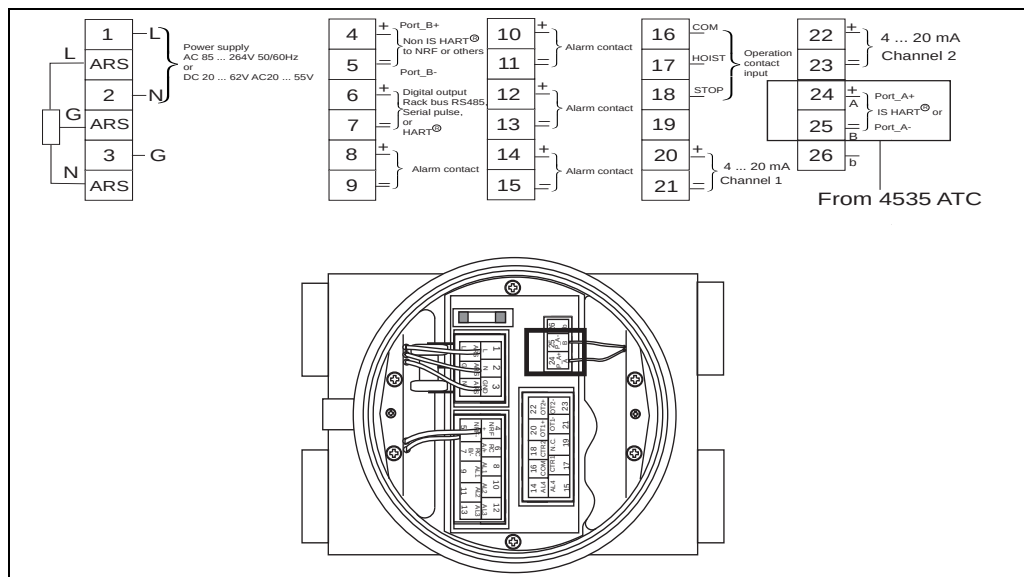


Figure 6-2: 6000 Series Servo Tank Gauge terminal

Note! Do not connect the 4532 ATC HART communication on terminals 4 and 5 on the 6000 Series Servo Tank Gauge. These terminals are designed to connect Ex d HART communication.

6.1.3 4590 TSM i.s. terminal

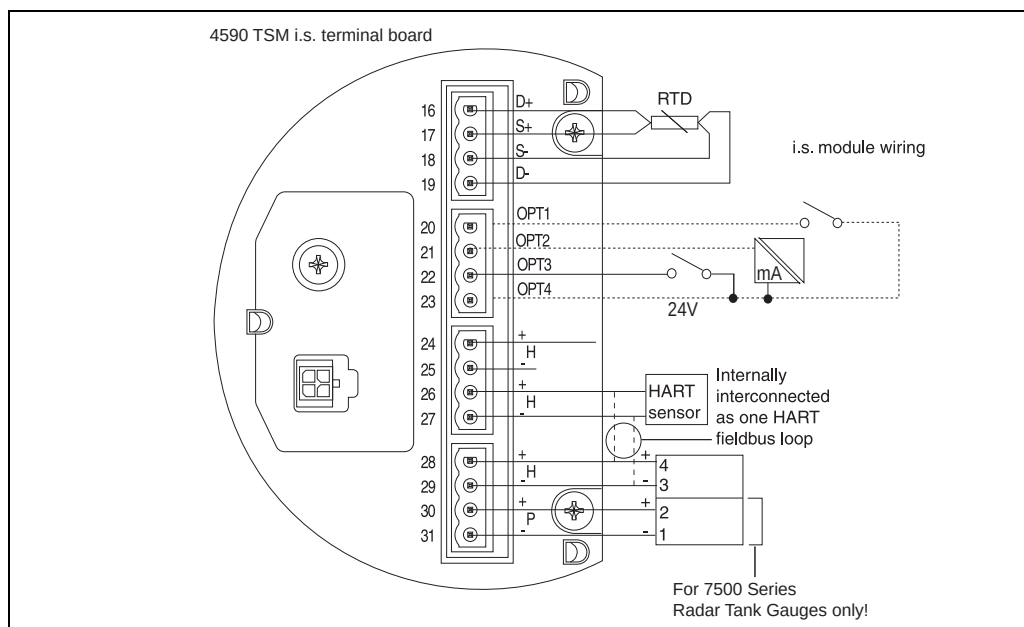


Figure 6-3: 4590 TSM terminal

Note! The 4590 TSM has three sets of i.s. HART terminals. These three pairs are looped internally.

Caution! Do not connect signal HART lines from the 4532 ATC to terminals 30 and 31. They are designed to supply drive power for the 7500 Series Radar Tank Gauge only.

6.2 Grounding

The 4532 ATC must be grounded to the tank potential before communication and power connections are made. The connections from ground terminal of the 4532 ATC to the tank ground must be made before any other wiring connections are made. All grounding must be compliant with local and company regulations and checked before the equipment is commissioned.

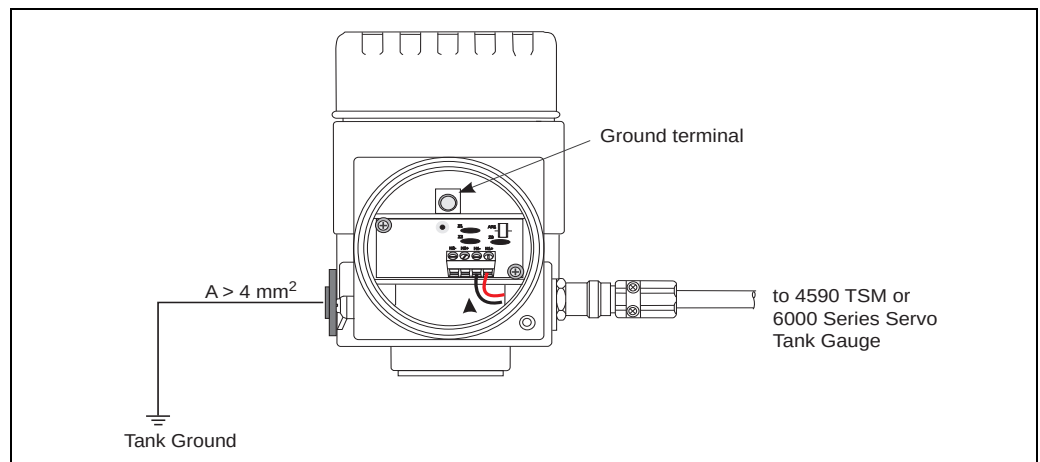


Figure 6-4: The 4532 ATC Grounding

7 Operating

7.1 Local HART connection

7.1.1 As a Varec tank gauging instrument

The 4532 ATC has been developed and designated primarily to work with the Varec tank gauging host instruments 4590 TSM or 6000 Series Servo Tank Gauge.

Temperature information is transmitted on a two wire i.s HART loop to the host instrument.

Since both the 4590 TSM and 6000 Series Servo Tank Gauge have a pre-configured menu for 453x average temperature devices functionality as default, simple wiring to the 4532 ATC will complete the initial setup for the 4532 ATC.

7.1.2 As a standalone generic HART instrument

The 4532 ATC is a HART foundation registered intrinsically safe loop powered device. The 4532 ATC provides four basic types of data as standard and parameter information via HART protocol, command 3. Configuration to host communication can be performed by a HC (Hand Communicator) or the Varec ToF field service tool to set a specific HART address.

20: Measurement function

- 0: Converter only
- 1: Temperature + converter

These four basic data are available as standard.

- Average liquid temperature
- Average gas phase temperature
- Level (entered liquid level at "VH02 measured distance")
- Device status

7.2 Device set up: 4590 TSM

Connect the loop powered HART communication cable from the 4590 TSM (intrinsically safe side compartment) to the 4532 ATC.

Since the 4590 TSM has been designed to recognize the 4532 ATC as a specific Varec HART instrument, set up is easy.

7.2.1 HART scanner

After the physical cabling between the 4532 ATC and the 4590 TSM is complete, scan all connected loop powered HART devices by activating "HART SCAN" on the version 1.x 4590 TSM. The version 2.x 4590 TSM continually scans the HART bus and will automatically detect the 4532 ATC when it is connected.

Caution! Not all 4590 TSM have fully accessible compatibility to recognize the 4532 ATC. Consult with your Varec representative to cross check the software and hardware version of the 4590 TSM.

7.2.2 The 4532 ATC specific parameter set up on the 4590 TSM

Configuration of 4532 ATC parameters on the display of the 4590 TSM is dependent on the installed software and hardware version of the 4590 TSM. Please refer to the operating manual for the 4590 TSM to determine accessible parameters.

All required initial setup and configuration can be performed by the ToF field service tool. Detailed information will be described in the following operation related chapters.

7.3 Device set up: 6000 Series Servo Tank Gauge

The 6000 Series Servo Tank Gauge is also specifically designed to recognize the 4532 ATC. Connect local HART cabling between the 4532 ATC and the 6000 Series Servo Tank Gauge on terminals 24 and 25.

7.3.1 Preparation of 6000 Series Servo Tank Gauge

The 6000 Series Servo Tank Gauge must be pre-configured to accept the 4532 ATC connection via the multi drop HART loop.

GVH362: NMT connection

"Average Temp." must be selected in order to configure the 4532 ATC.

Caution! To change this parameter, an access code is required. Please refer to the 6000 Series Servo Tank Gauge operation manual for further information.

7.3.2 4532 ATC configuration on 6000 Series Servo Tank Gauge

Most required 4532 ATC parameters can be configured on G4 "Temperature" matrix as it is on the display of the 6000 Series Servo Tank Gauge.

Typical 4532 ATC parameters (equivalent to the 4535 ATC) are displayed on the matrix of the 6000 Series Servo Tank Gauge.

7.3.2.1 G0 Static matrix

GVH010: Liquid Temp

Calculated average liquid temperature value, determined by the 4532 ATC

GVH013: Gas Temperature

Calculated average gas phase temperature value, determined by the 4532 ATC

GVH440: Liquid Temp

The same value indicated on GVH010 Liquid Temp

GVH441: Gas Temperature

The same value indicated on GVH013 Gas Temperature

GVH442: Measured Level

Liquid level value established in the 6000 Series Servo Tank Gauge. The 4532 ATC must have liquid level data in order to calculate both liquid and gas phase average temperature.

GVH447: Reference Zero

Indication of the converted 100 Ohm reference resistor deviation value compared to the actual inserted element value in the temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing an incorrect calculation. Indicated tolerance should be within $\pm 0.15^{\circ}\text{C}$ ($\pm 0.27^{\circ}\text{F}$) depending on element characteristics, e.g. Pt100 elements have 100 Ohm resistance at 0°C (32°F); therefore, the reading value should be within $0^{\circ}\text{C} \pm 0.15^{\circ}\text{C}$ ($32^{\circ}\text{F} \pm 0.27^{\circ}\text{F}$) or less.

GVH449: Reference 150

Indication of the converted 200 Ohm reference resistor deviation value compared to the actual inserted element value in the temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing an incorrect calculation. Indicated tolerance should be within $\pm 0.15^{\circ}\text{C}$ ($\pm 0.27^{\circ}\text{F}$) depending on element characteristics.

GVH450~459; Temp No.1~10

The temperature reading value from each inserted element in the probe. The reading element temperature above 11~16 must be selected at the GVH470 "Select Point", then the read value at the GVH473 "Element Temp."

GVH460~49; Element Position No.11~16 (not available with 4532 ATC)**GVH470: Select Point**

A matrix to select the desired element data on GVH471 "Zero Adjust", GVH473 "Element Temp" and GVH474 "Element Position."

GVH480: Diagnostic

Display of error code message. Please refer to the error code chart in Chapter 9, Maintenance.

GVH482: Total No. Element

Enter the number of installed temperature elements in the average temperature probe.

GVH485: Type of Interval

Select type of element interval.

Even: Element spacing will be equally spaced by providing the distance at GVH487 "Element Interval", and the lowest element position can be set at GVH486 "Bottom Point."

GVH486: Bottom Point

The lowest inserted element position in the average temperature probe.

Note! This parameter setting is only used to change the theoretical element position within the 4532 ATC's software for average calculation purposes. It does not effect the physical location of the temperature element position.

8 Operation and Description of Instrument Function

8.0.1 HART Device designation

HART device code "190":

Device code for temperature measurement function in 4532 ATC only.

8.0.2 Device Data

Tag Number: read and write

Default: HART

A customer specific device identification and control number (or name). Tank name, site number, or any other ID can be entered.

Assembly Number: read and write

Default: 0

Manufacture control number based on production process.

8.1 Temperature measurement

8.1.1 Primary values: VH00 ~ VH09

VH00 Liquid Temp

Item type: read only

Range: -200°C ~ 240°C

Note! Display of measured liquid phase average temperature. Liquid level input must be provided by the 7200 or 7500 Series Radar Tank Gauge (via 4590 TSM) or 6000 Series Servo Tank Gauge in order to calculate true liquid average temperature.

VH01 Gas Temp

Item type: read only

Range: -200°C ~ 240°C

Display of measured gas (vapor) phase average temperature.

Note! Display of measured gas (vapor) phase average temperature. Liquid level input must be provided by the 7200 or 7500 Series Radar Tank Gauge (via 4590 TSM) or 6000 Series Servo Tank Gauge in order to calculate true gas average temperature.

VH02 Measured Distance

Item type: read and write

Range: 0mm ~ 99999mm

Display of provided liquid level by connected level gauge. Manual level input is also available for the purpose of device testing.

VH07 Temperature 0

Item type: read only

Display of converted 100 Ohm reference resistor deviation value compared to actual inserted element value in temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent an incorrect calculation.

VH09 Temperature 17

Item type: read only

Display of the converted 200 Ohm reference resistor deviation value compares to the actual inserted element value in the temperature probe. The reading value of the reference resistor and its deviation are continuously monitored during operation to prevent an incorrect calculation. Indicated tolerance should be within $\pm 0.15^{\circ}\text{C}$ ($\pm 0.27^{\circ}\text{F}$) depending on element characteristics.

8.1.2 Element Temperature 1: VH10 ~ VH15

(VH16~19 used only in 4539 ATC539)

VH10 ~ 19 Temperature 1 ~ 10

Item type: read only

Range: -200°C ~ 240°C

Display of individual measured element temperature.

8.1.3 Element Temperature 2: VH20 ~ VH29

(not available in 4532 ATC)

VH26 Selec. Ave Method

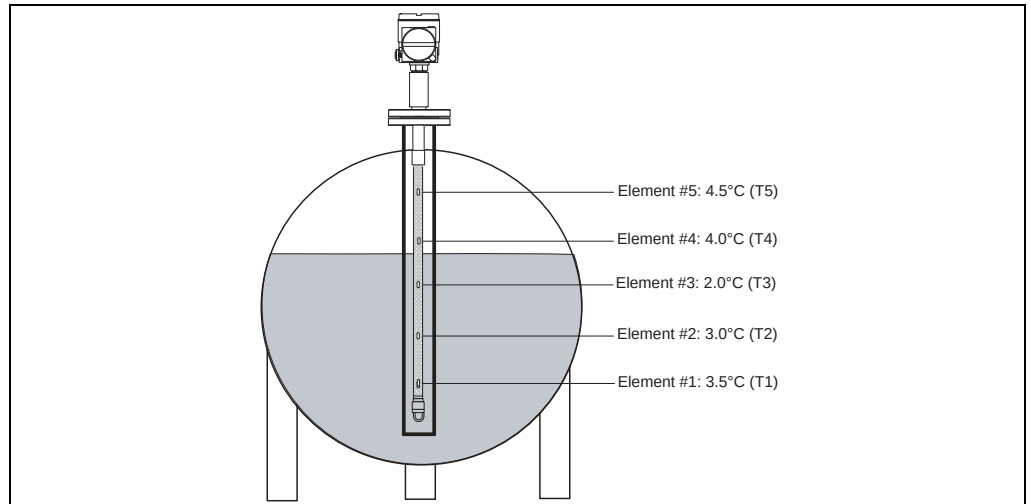
Item type: select

Selection: Standard, Advanced

Selection of average calculation method.

Standard

A Conventional calculation method. Regardless of tank shape, average temperature calculation will be performed based on the following example (example: liquid temperature).

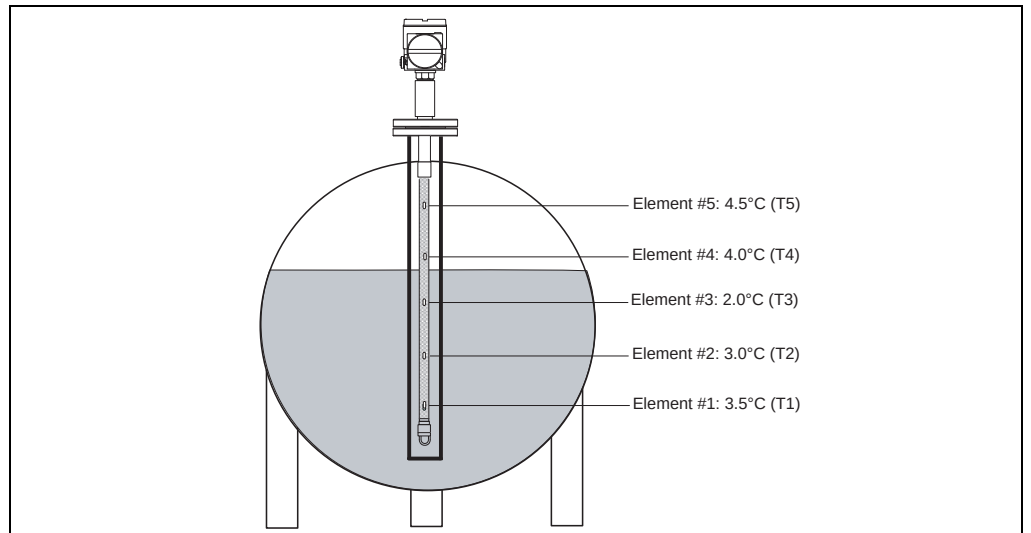


Formula: $(T1 + T2 + T3) / \# \text{ of element in liquid phase}$

= Average temperature $(3.5^{\circ}\text{C} + 3.0^{\circ}\text{C} + 2.0^{\circ}\text{C}) / 3 = 2.83^{\circ}\text{C}$

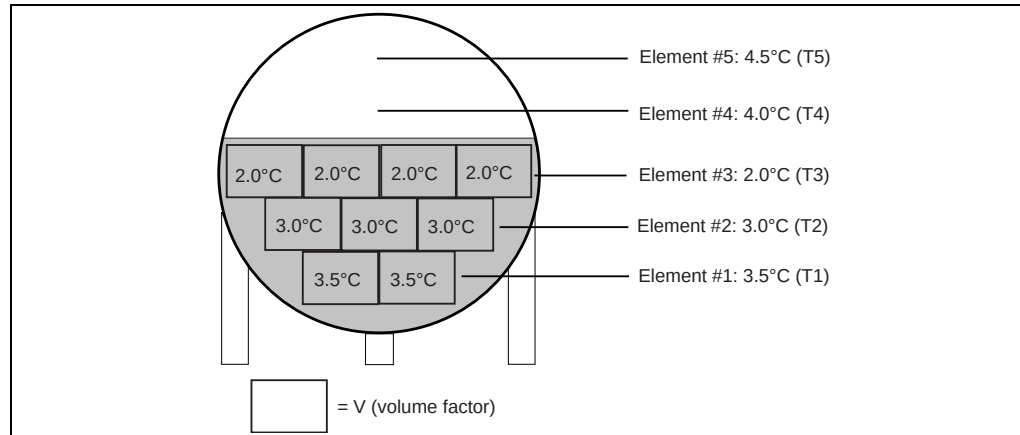
Advanced:

Average temperature calculation with additional factor to compensate for unequal volume distribution (example: liquid temperature)



Formula: $(T1*V1 + T2*V2 + T3*V3) / (V1 + V2 + V3) = \text{Average temperature}$

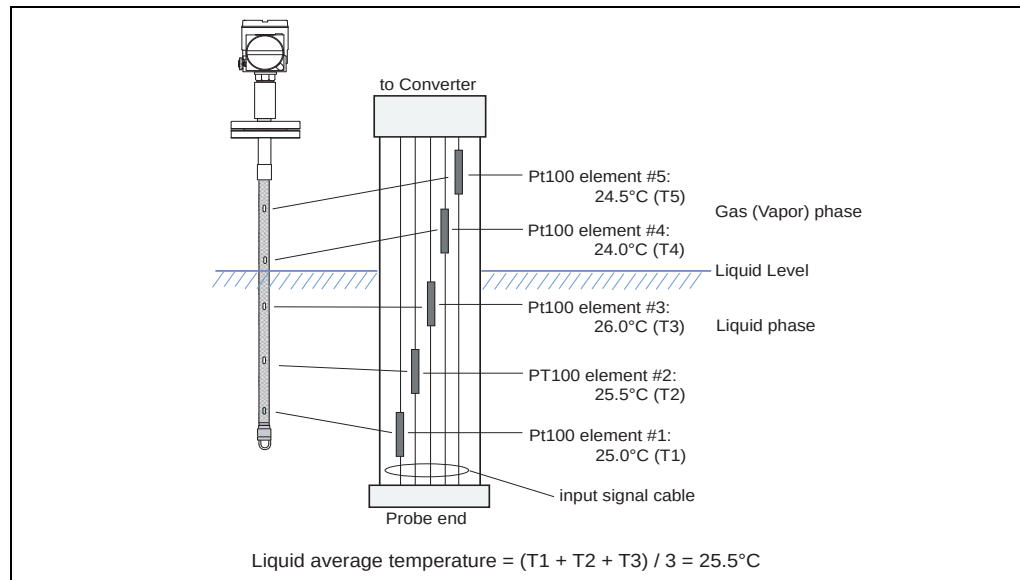
Note! V = # of additional volume factors and related parameters are determined at VH53, 54 and 55.



$$(3.5^{\circ}\text{C} \times 2 + 3.0^{\circ}\text{C} \times 3 + 2.0^{\circ}\text{C} \times 4) / (2 + 3 + 4) = 2.67^{\circ}\text{C}$$

Spot

The same number of elements (resistance and material) are located in each input cable in the probe. Average calculation is performed based on the sum of submerged element temperature values / total number of element submerged.



VH28 Lower Limit

Item type: read and write

Default value: -20.5°C

RANGE: $-999.9^{\circ}\text{C} \sim 999.9^{\circ}\text{C}$

Low limit temperature alarm setpoint.

VH29 Upper Limit

Item type: read and write

Default value: 245°C

Range: -999.9°C ~ 999.9°C

Hi limit temperature alarm setpoint.

**8.1.4 Element Position 1: VH30 ~ VH35
(VH36~VH39 is used only in 4539 ATC)**

VH30 ~VH39 Position 1 ~ 6 (7~10 is used only in 4539 ATC)

Item type: read and write

Range: 0mm ~ 99999mm

Individual element position from tank bottom. Calculation is automatically performed when element spacing "Even" is selected at VH85.

8.1.5 Element Position 2: VH40 ~ VH45 are not available in 4532 ATC**VH46 Hysteresis Width**

Item type: read and write

Default: 10mm

Range: 0mm ~ 99999mm

Element switching point hysteresis. The hysteresis is an offset value added to the liquid level when the level is increasing, and subtracted from the liquid level when the level is decreasing. This setting ensures that the temperature value from an uncovered temperature element is not used in calculating the average temperature.

VH47 Clear Memory

Item type: select

Default: None (0)

Selection: None, Clear

Reset matrix parameter to default setting.

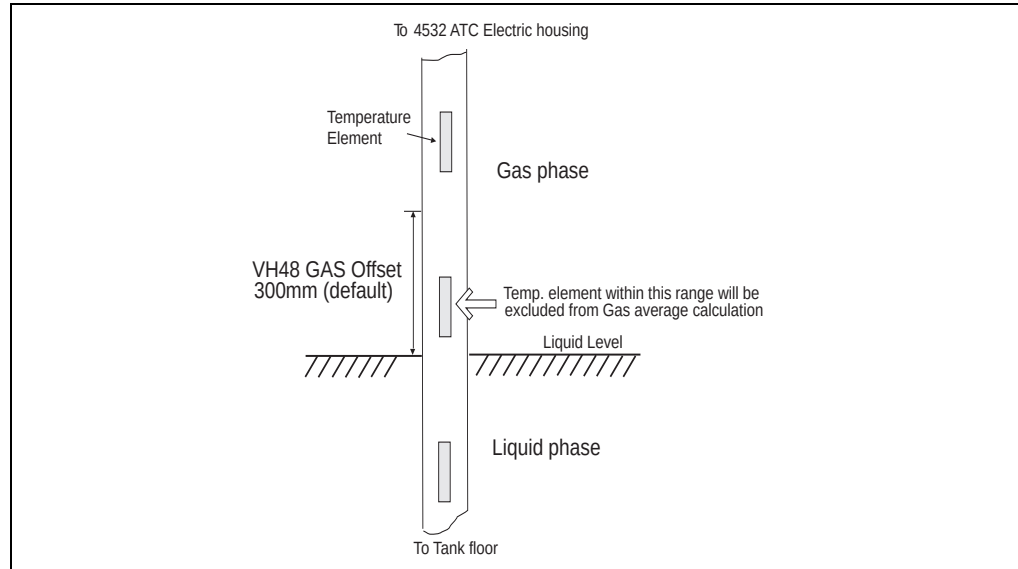
VH48 Gas Offset

Item type: read and write

Default: 300mm

Range: 0mm ~ 99999mm

A function to exclude specific element(s) from the gas (vapor) phase average temperature calculation when the uncovered element(s) is (are) within the entered value from the liquid level.

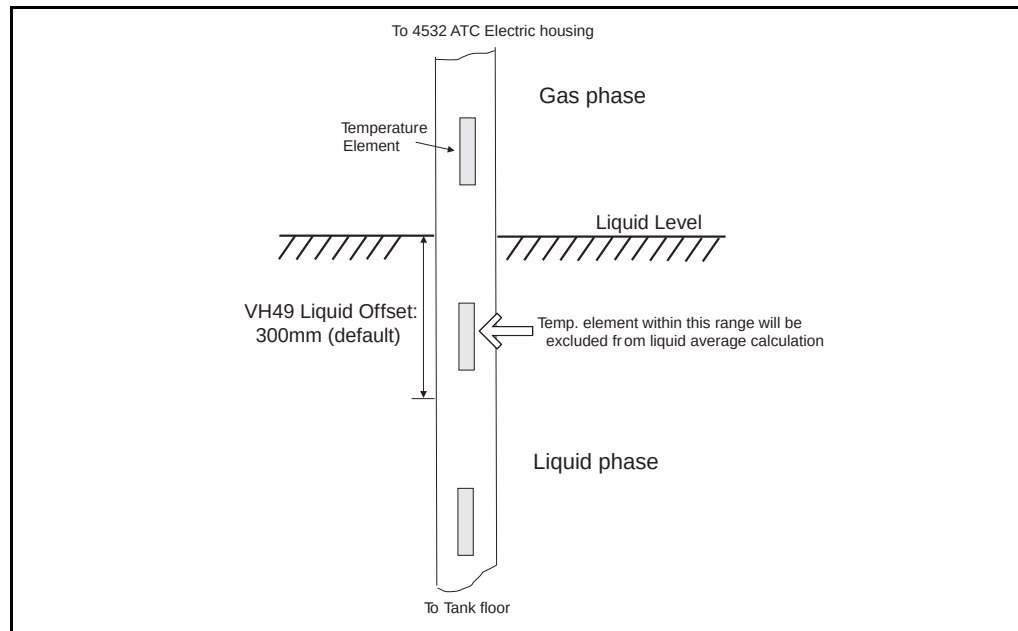
**VH49 Liquid Offset**

Item type: read and write

Default: 300mm

Range: 0mm ~ 99999mm

A function to exclude element (s) from the liquid phase average temperature calculation when the uncovered element(s) is (are) within the entered value from the liquid level.



8.1.6 WB primary and Advanced temp: VH50 ~ VH59

VH53 Element Point

Item type: select

Default: 0

Selection: 0 ~ 15 (element #1 = 0, element #6 = 5)

Select element number for "Advanced" average calculation at VH26. Selected element position will be displayed on VH54 "Element Position" and allow modification of the volume factor at VH55 "Element Volume" for the specified element.

VH54 Element Position

Item type: read only

Range: 0m ~ 99999mm

A display of selected element position on VH53.

VH55 Element Volume

Item type: read and write

Range: 1 ~ 99999.9

For the selected element at VH53 "Element Point", extra volume can be added to the specified element for advanced average temperature calculation. (For details, refer to the description of VH26 "Select Average Method" on page 30)

8.1.7 WB Adjustment and Operation Power: VH60 ~ VH69

VH67 Common Voltage

Item type: read only

Range: 0 ~ 255 (0 ~ 3V)

A display of temperature element line (both signal and common) running voltage. The detected voltage across the common line (between 0 ~ 3V) is converted to a range of 0 ~ 255 counts when it is displayed.

VH68 Output Current

Item type: read and write

Default: 16000 at 6mA

Range: 0 ~ 65536

Adjustment of 4532 ATC current consumption. In order to prevent current over-shoot within the multidrop HART loop, this function limits the 4532 ATC power consumption based on the set parameter. Normally, the 4532 ATC requires 6 mA or less current. Use a tester to check the current flow in the loop. Reducing this parameter makes the 4532 ATC use less current.

VH69 Ref Voltage

Item type: read and write

Default: 200

Range: 0 ~ 255

This parameter is the setpoint for the 4532 ATC power supply failure alarm. The 4532 ATC operates with a minimum 16 VDC supply voltage via the multi-drop HART loop under normal operating conditions. The 4532 ATC transmits an error message when the supply voltage drops below 16 VDC. The default value of 200 is equivalent to 16 VDC.

8.1.8 Temperature Adjustment: VH70 ~ VH79**VH70 Element Select**

Item type: select

Range: 0 ~ 19

Allows selection of individual temperature elements for adjustment (0 = #1 element, 5 = #6 element, 19 = reference 100 Ohm resistor). Detailed values and parameters of the selected element can be shown in:

- VH71 "Zero Adjust"
- VH73 "Temperature X"
- VH74 "Position X"
- VH75 "Resistance X"
- VH76 "Resistance Adj"

VH71 Zero Adjust

Item type: read and write

Default: 0

Range: -1000.0 ~ 1000.0

Zero adjustment of the individual element selected at VH70. This value can be adjusted when the measured temperature of the selected element has a minor offset value as compared to a precision reference thermometer.

For example: Selected element #2 indicates 25.4 °C. The reference thermometer indicates 25.2 °C. Enter "-0.2" in VH71. Element #2 now has a constant offset applied to the raw measurement.

VH72 Adjust Span

Item type: read and write

Default: 1

Range: 0.8 ~ 1.2

This span adjustment applies to all installed temperature elements. This parameter is multiplied by the raw measurement for each individual element to calculate the calculated temperature for each individual element.

Note! All of displayed individual temperature values are calculated based on the following formula.

VH73: "Temperature X" = raw element temperature x span (VH72) + zero offset (VH71)

VH73 Temperature X

Item type: read only

Specified element temperature selected at VH70. The displayed value is also indicated at individual element temperature at VH10 ~ VH25. The value is calculated based on formula indicated on above VH72.

VH74 Position X

Item type: read and write

Range: 0mm ~ 99999mm

The position of the element specified at VH70. The position of each element is entered when "Not Even" element spacing is selected at VH85.

VH75 Resistance X

Item type: read only

The display of the specified element resistance selected at VH70.

VH76 Resistance Adj.

Item type: read and write

Default: 0

Range: -1000.0 ~ 1000.0

Adjustment of specified element resistance at VH70. Minor resistance adjustment can be applied on the reading value.

Note! e.g. If selected element #5 indicates 100.3 Ohm, and reference precision resistor indicates 100.0 Ohm at the same environmental condition, then set "-0.3" in this matrix. #5 element now has constant artificial -0.3°C offset resistance based on raw measurement.

VH77 Element Type

Item type: select

Selection: Pt100 (must be selected in 4532 ATC)

Note! The 4532 ATC always consists of "Pt100" elements with "Spot" element layout. Do not attempt to change these parameters.

VH78 Average Number

Item type: read and write

Default: 1

Range: 1 ~ 10

Number of samples for calculating the average temperature. Increasing this parameter will prevent erratic changes in the calculated value.

Caution! Additional sampling # will cause slower reaction time on value switch over. Maximum 1 sampling sequence will take approximately 2 sec. {total 11 elements (6 temp elements and 5 times for 3 reference resistors)}

VH79 Protect Code

Item type: read and write

Default: 0

Range: 0 ~ 999

Access code 530 required to modify parameters.

Device setting 1: VH80 ~ VH89

VH80: Present Error

Item type: read only

Display of current error message. One of the following codes will be indicated:

Error code

- 0: No error presence
- 1: Common line open
- 2: undetermined
- 3: #1 element open
- 4: #1 element short
- 5: #2 element open
- 6: #2 element short
- 7: #3 element open
- 8: #3 element short
- 9: #4 element open
- 10: #4 element short
- 11: #5 element open
- 12: #5 element short
- 13: #6 element open
- 14: #6 element short
- 23: #0 element over range
- 24: Memory defect (ROM)
- 29: Element exposed (liquid level below #1 element position)
- 30: undetermined
- 31: undetermined
- 41: Memory defect (RAM)
- 42: Memory defect (EEROM)

VH81 Temperature Unit

Item type: select

Default: °C

Selection: C, F, K

Selection of temperature display unit. Based on universal HART setting, °C(HART code: 32), °F(HART code: 33) and °K(HART code: 35) are available.

Note! Selection of temperature display unit only applies to reply data from 4532 ATC. Data transmission from host gauge (4590 TSM or 6000 Series Servo Tank Gauge) to 4532 ATC must be performed by °C unit only (terminology of HART command 133)

VH82 Element Number

Item type: read and write

Default: 2

Range: 1 ~ 6

Number of available temperature elements.

Do not change the default parameter on the 4532 ATC. The number of elements on this version is pre-determined by the customer's choice. It may cause faulty calculation or an inappropriate error display.

VH83 No. of Preambles

Item type: read and write

Default: 5

Range: 2 ~ 20

Number of preambles for HART communication.

VH84 Distance Unit

Item type: select

Default: mm

Selection: ft., m, inch, mm

Selection of level display unit. It applies to liquid level display on VH02 "Liquid Level". Level units are coded based on universal HART setting, ft. (HART code: 44), m (HART code: 45), inch (HART code: 47), mm (HART code: 49).

VH85 Kind of Interval

Item type: select

Default: Even Interval

Selection: Even Interval (always "Even" for 4532 ATC)

Selection of element interval depending on spacing layout.

Caution! Do not change this parameter on the 4539 ATC Converter + Temperature version unless repairing. The type of Interval and individual element positions are physically determined at factory.

VH86 Bottom Point

Item type: read and write

Default: 500mm

Range: 0mm ~ 99999mm

Position of #1 element. The #1 element position becomes critically important when "Even Interval" is selected at VH85 because remaining element positions rely on the location of the Bottom Point.

VH87 Element Interval

Item type: read and write

Default: 1000mm

Range: 0mm ~ 99999mm

Applies only when Even Interval spacing is selected.

Caution! Changing element interval, setting element position, these are only applied to reconfigure switching points for average temperature calculation. The physical element position will never be changed.

VH88 Short Error

Item type: read and write

Default: -49.5

Range: -49.5 ~ 359.5

Error message displayed when any element has a short circuit. Method of display can be configured at VH92 "Error Display Select."

VH89 Open Error

Item type: read write

Default: 359.9

Range: -49.5 ~ 359.5

Error element displayed when any element has an open circuit. Method of display can be configured at VH92 "Error Display Select."

8.1.9 Device setting 2: VH90~VH99**VH90 Device ID Number**

Item type: read and write

Default: 0

Range: 0 ~ 16777214

In order to distinguish own device ID when 4532 ATC is connected in multi drop HART loop.

Caution! Changing device ID may lead to communication error because of mismatched pre-registered device ID and HART address.

VH91 Previous Error

Item type: read only

Display of error history. Coded error message will be the same contents as VH80.

VH92 Error Dis. Sel.

Item type: select

Default: 0_OFF

Selection: 0_OFF, 1_ON

Type of VH88 "Short Error Value" and VH89 "Open Error Value" display selection.

0_OFF: These 2 error messages will not be transmitted to the connected host gauge. This function automatically excludes defect element in average temperature calculation.

1_ON: Error message will be transmitted to the host gauge. As a result, VH88 and 89's numeric error code will be displayed on host gauge default screen and may transmit to upper receiver as well.

VH94 Polling Address

Item type: read and write

Default: 2

Range: 1 ~ 15

Polling address for HART communication

VH95 Manufacture ID

Item type: read only

Default: 17

The manufacturer ID for Endress+Hauser instrumentation.

VH96 Software Version:

Item type: read only

A display of installed software version.

VH97 Hardware Version

Item type: read only

A display of installed hardware version.

VH98 Below Bottom

Item type: select

Default: 0_OFF

Selection: 0_OFF, 1_ON

A type of error display when liquid level drops below #1 element (Bottom Point). Error code "29" is displayed on VH80 and VH91 when 0_ON is selected.

VH99 Device Type Code

Item type: read only

Device type will be displayed.

190: Temperature measurement function only.

9 Maintenance

The 4532 ATC Average temperature instrument requires no special maintenance.

9.1 Exterior cleaning

When cleaning the 4532 ATC, always use cleaning agents that do not attack the surface of the housing and the seals.

9.2 Repairs

The Varec repair concept assumes that the measuring devices have a modular design and that customers are able to undertake repairs themselves. Spare parts are contained in suitable kits. They contain the related replacement instructions. All the spare parts kits which you can order from Varec for repairs to the 4532 ATC are listed with their order numbers on later pages. Please contact Varec Service for further information on service and spare parts.

9.3 Repairs to Ex-approved devices

When carrying out repairs to Ex-approved devices, please note the following:

- Repairs to Ex-approved devices may only be carried out by trained personnel or by Varec Service.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and certificates.
- Only use original spare parts from Varec.
- When ordering a spare part, please note the device designation on the nameplate. Only replace parts with identical parts.
- Carry out repairs according to the instructions. On completion of repairs, carry out the specified routine test on the device.
- Only Varec Service may convert a certified device into a different certified variant.
- Document all repair work and conversions.

9.4 Replacement

After a complete 4532 ATC electronic module has been replaced, the parameters must be manually re-entered to the replaced new module in order to maintain the proper operation. Measurement can continue without having to carry out a new setup.

The following matrix parameters should be confirmed after replacement of the electronics.

GVH	Contents
443	Level Data Selection
460-469	Element Position No. 1-9
470	(to select elements 10-15)
474	(to adjust position of element selected at GVH=470)
482	Total No. elements
485	Kind of Interval
486	Bottom point
487	Element Interval (If GVH=485 is "Equal")

10 Troubleshooting

10.1 System error messages

Code	Description	Possible cause	Remedy
1	Common line open	Ground (common) line has open circuit. All temperature element signals will be disabled or inaccurate.	Check connector attachment on the module; then check continuity on common (black & white) cable
3~39	Element open	Temperature element signal cable (#1 ~ 6) has open circuit.	Check connector attachment on the module; then check continuity on pointed signal cable (#1 ~ 6)
4~40	Element short	Temperature element signal cable (#1 ~ 6) has short circuit.	Disengage connector from the module; then check continuity on pointed signal cable (#1 ~ 6)
23	#0 element over range	When reference #0 element has more than $\pm 1.1^{\circ}\text{C}$ deviation from 0°C .	Check power supply voltage on 4532 ATC HART terminal H+ and H-
24	Memory defect (ROM)	When a defect was discovered during whole memory parameter check. Cyclic data comparison between previous check sum to current one.	Replace main CPU board
29	Element exposed	Liquid level dropped below #1 element position.	No liquid temperature measurement is available.
32	Low power supply	Supply voltage on multi drop HART loop to 4532 ATC is below 16VDC from designated host instrument.	Check power supply on the host instrument and consumption of connected loop powered HART device
41	Memory defect (RAM)	Fault during Write and Read sequence, not completed.	Replace main CPU board
42	Memory defect (EEROM)	Fault during Write and Read sequence, not completed.	Check the write command itself that is acceptable to 4532 ATC; if command is OK, replace main CPU board

These error codes are displayed on the ToF tool display when the ToF tool is properly connected. For details regarding the error display on host instrument, please refer to documentation of 4590 TSM or 6000 Series Servo Tank Gauge.

10.2 Spare parts

Spare parts are contained in kits. Spare parts which you can order from Varec for the 4532 ATC are shown with their order numbers in the diagram below. For more information on service and spare parts, contact Varec.

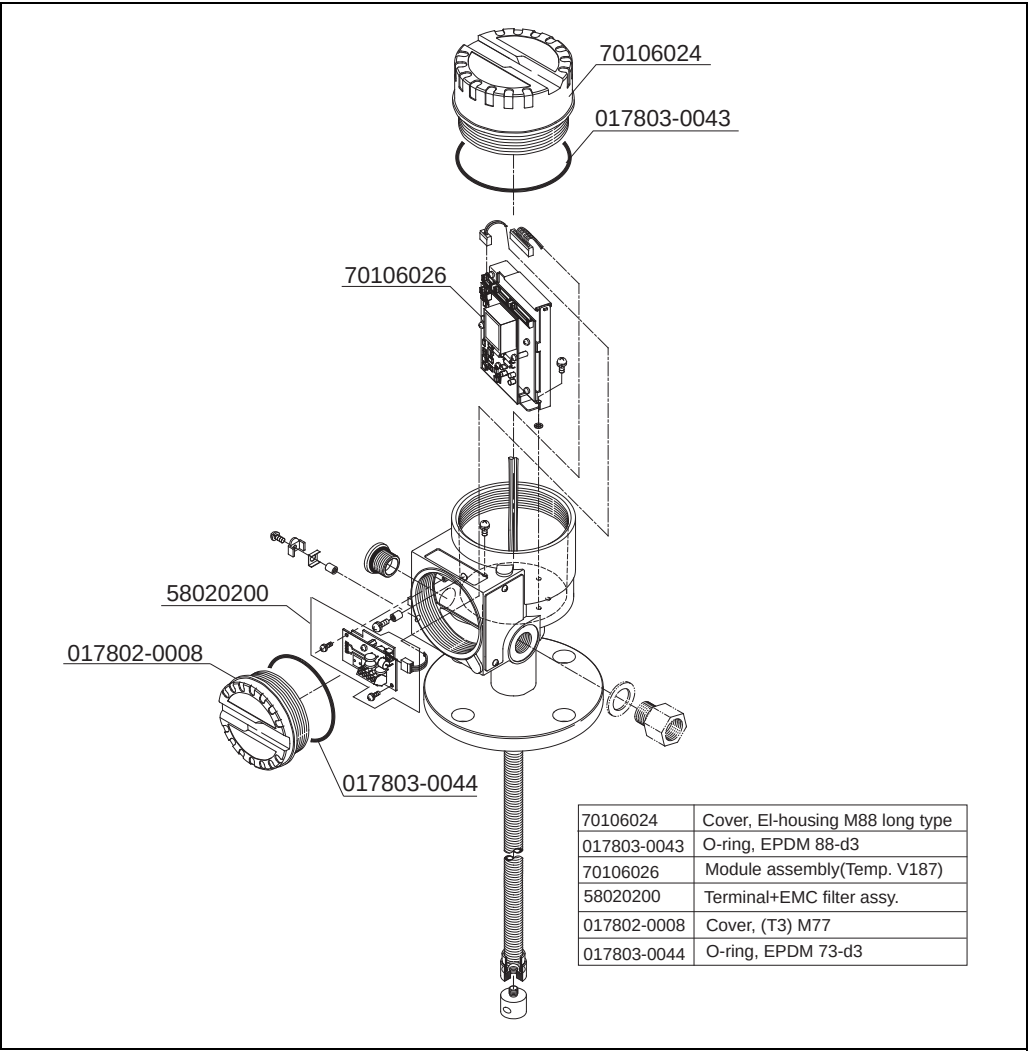


Figure 10-1:Spare Parts

11 Accessories

11.1 Anchor weight (Tall profile)

Caution! Installation of anchor weight will cause element position #1 (the lowest temperature measurement position) to be raised approximately 500 mm (20") from the tank floor.

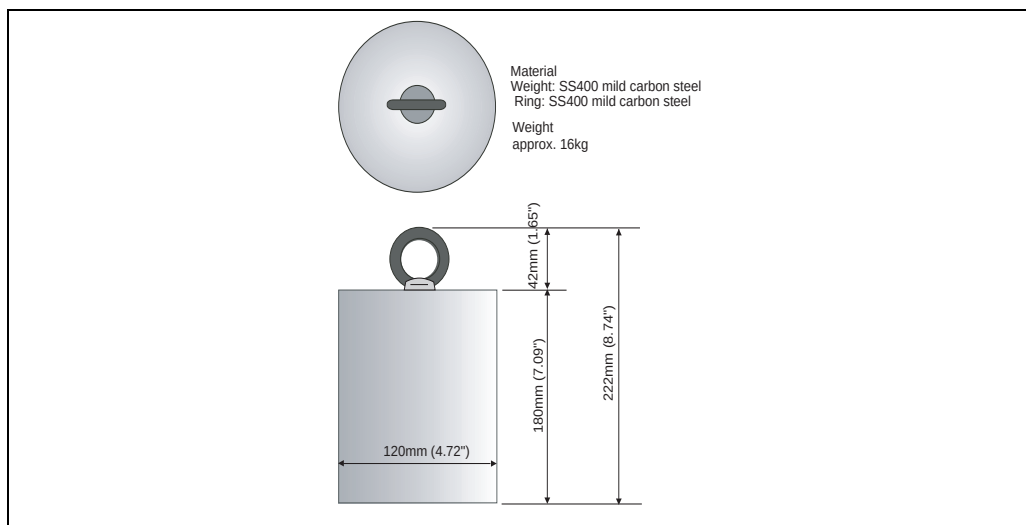


Figure 11-1:Anchor weight dimension

Different dimension, weight, and material anchor are also available. Consult your Varec representative for further details.

11.2 Anchor weight (Low profile)

The low profile anchor weight is a version for an existing tank installation with a small nozzle opening for converter and temperature version.

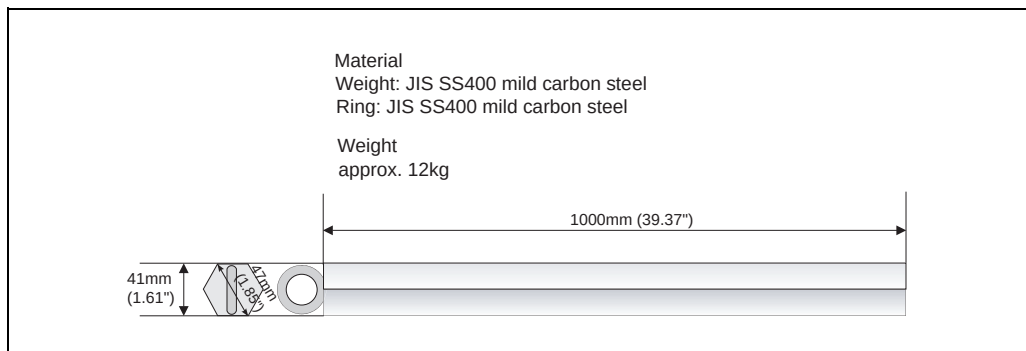


Figure 11-2:Low profile anchor weight dimension

11.3 Wire hook, Top anchor

Anchor weights are supplied with SUS316 standard 3 mm diameter tension wire for attaching anchor weight to temperature probe.

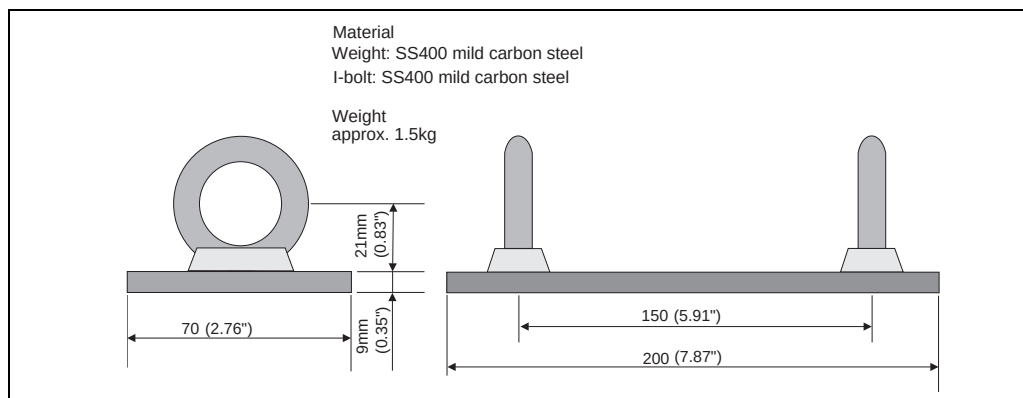


Figure 11-3: Wire hook dimension

Actual tensioning can be completed with SUS316 stranded 3 mm diameter tension wire between Wire hook and Top anchor. Based on the application and installation variable, type of wire & size, material, and special coatings are available. Please consult your Varec representative for further details.

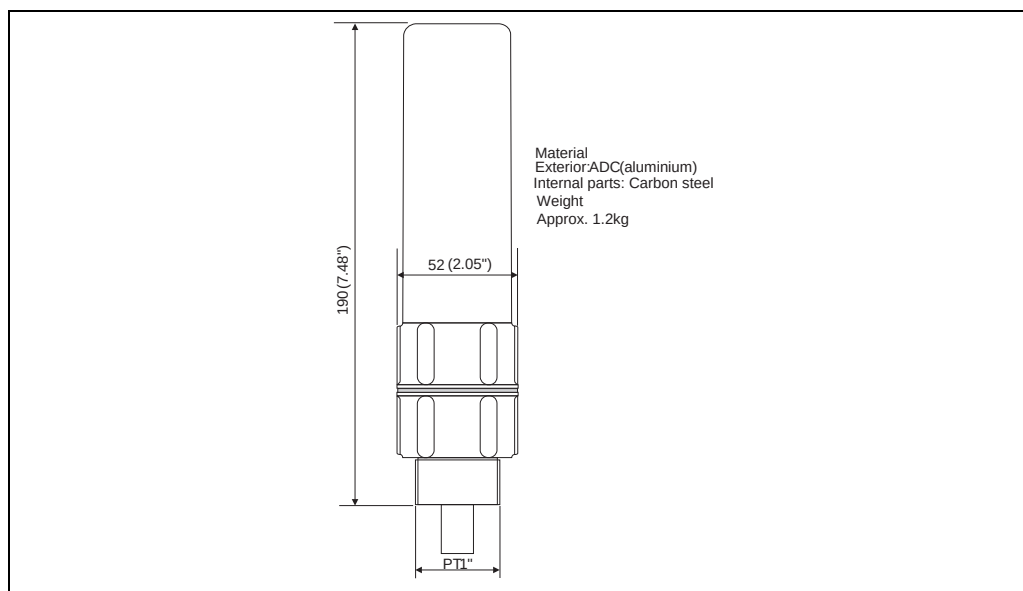


Figure 11-4: Top anchor dimension

Note! The standard process connection of the Top anchor is NPT1" threaded connection. Different thread size, material, and specification are available. Flange type connection is also available.

12 Technical data

Technical data at a glance:

Application	
Application	The 4532 ATC performs precise liquid and gas phase average temperature measurement in bulk storage tank applications. • Standard 2" flange installation • Overall 18.5m temperature measurement range
Function and system design	
Measuring principle	Temperature measurement • Up to 6 elements spaced evenly over the length of the flexible tube. • Pt100, Class A elements
Input	
Measured variable	Temperature measurement Temperature conversion range: $-20 \sim +100^{\circ}\text{C}$
Measuring range	$-20 \sim +100^{\circ}\text{C}$ ($-4 \sim 212^{\circ}\text{F}$)
Output	
Output signal	• HART protocol (multi drop HART loop connection)
Signal on alarm	Error information can be accessed via the following interfaces and transmitted digital protocol (refer to the operation manuals on following instruments) • Tank Side monitor 4590 TSM • 6000 Series Servo Tank Gauge
Auxiliary energy	
Load HART	Minimum load for HART communication: 250 W
Cable entry	see technical document
Supply voltage	16 ~ 30VDC (on multi drop HART loop)
Current consumption	Less than 6mA
Performance characteristics	
Reference operating conditions	• temperature = $+25^{\circ}\text{C}$ (77°F) $\pm 5^{\circ}\text{C}$ (9°F) • pressure = 1013 mbar abs. (14.7 psia) ± 20 mbar (0.3 psi) • relative humidity (air) = 65 % $\pm$ 20%
Maximum measured error	Typical statements for reference conditions, include linearity, repeatability, and hysteresis: • Linearity: • Temperature: $\pm 0.15^{\circ}\text{C}$ (0.27°F) + number of element deviation (based on IEC class A standard)

A Order Structure

10	Protection class	
7	FM, IS class1, Div.1, Gr. A-D	
B	ATEX, EEx [ia] IIB T4 -T6	
20	Cable entry	
B	Thread NPT 1/2	
D	Thread M20	
30	Process connection (SUS304)	
1	2" 150lbs RF, 304 flange ANSI B16.5	
2	DN50 PN0 B1, 304 flange EN1092-1 (DIN2527 C)	
9	Special version, to be specified	
40	Element #, Interval, Probe range (Below flange to end of probe)	
022	...mm; 2x Pt100; 2 m (min 2,500 mm, max 4,500 mm)	
032	...mm; 3x Pt100; 2 m (min 4,500 mm, max 6,500 mm)	
042	...mm; 4x Pt100; 2 m (min 6,500 mm, max 8,500 mm)	
052	...mm; 5x Pt100; 2 m (min 8,500 mm, max 10,500 mm)	
062	...mm; 6x Pt100; 2 m (min10,500 mm, max 12,500 mm)	
023	...mm; 2x Pt100; 3 m (min 3,500 mm, max 6,500 mm)	
033	...mm; 3x Pt100; 3 m (min 6,500 mm, max 9,500 mm)	
043	...mm; 4x Pt100; 3 m (min 9,500 mm, max 12,500 mm)	
053	...mm; 5x Pt100; 3 m (min 12,500 mm, max 15,500 mm)	
063	...mm; 6x Pt100; 3 m (min 15,500 mm, max 18,500 mm)	
50	Specific probe length, Length within selected item at Pos. 040(UP to max. 18,500)	
A	Not selected	
B	Anchor weight, tall profile	
C	Anchor weight, low profile	
D	Tensioning wire, wire hook, top anchor	
4532 -		Complete product designation

B Declaration of Contamination Form

Declaration of Contamination



For the safety of our employees and operating equipment, we require that you fill out this form and return it to Varec with your signature before we can fulfill your order. Please include the completed form with the device and shipping documents, along with safety sheets and/or specific handling instructions if appropriate.

Type of device/sensor: _____ Serial no.: _____
 Medium/concentration: _____ Temperature: _____ Pressure: _____
 Cleaned with: _____ Conductivity: _____ Viscosity: _____

Warnings for returned device (mark the appropriate symbols)



radioactive



explosive



caustic



poisonous



harmful to
health



biologically
hazardous



inflammable



safe

Reason for return _____

Company data

Company	_____	Contact person	_____
	_____		_____
Address	_____	Department	_____
	_____	Phone	_____
	_____	FAX / e-mail	_____
	_____	Order number	_____

I hereby certify that the returned equipment has been cleaned and decontaminated according to standard industrial practices and is in compliance with all regulations. This equipment poses no health or safety risks due to contamination.

 Place, date

 Company stamp and signature

Varec, Inc., an SAIC Company
 5834 Peachtree Corners East, Norcross (Atlanta), GA 30092 USA
 Tel: +1 (770) 447-9202 Fax: +1 (770) 662-8939

Index

D

Designated use 1

E

explosion-proof type 3

G

Grounding 4

H

Hazardous Substance Datasheet 4

I

installation & operation overview 1

M

Maximum measured error 51

Measuring principle 51

O

Overview, installation & operation 1

S

Safety conventions and symbols 5

Safety instructions 3

Software history 1

NOTES

Your official representative

Varec®



www.varec.com

Varec, Inc.

5834 Peachtree Corners East, Norcross (Atlanta), GA 30092 USA

Tel: +1 (770) 447-9202 Fax: +1 (770) 662-8939

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